A dissertation on

"EFFECT OF LAGHOO SHANKAPRAKSHALANA ON LIPID PROFILE AND ANTHROPOMETRIC MEASUREMENTS IN OBESE PERSONS"

By

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IN

YOGA

Under the Guidance of

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Date: Dr.A.Gayathri

LIST OF ABBREVATIONS

WHO	World Health Organisation
TC	Total Cholesterol
TGs	Triglycerides
VLDL	Very Low Density Lipoprotein
LDL	Low Density Lipoprotein
HDL	High Density Lipoprotein
LSP	Laghoo Shankaprakshalana
BMI	Body Mass Index
WHR	Waist Hip Ratio
CAD	Coronary Artery Disease
CETP	Cholesterol Ester transfer protein
OA	Osteo Arthritis
PSS	Perceived Stress Scale
AAQW	Acceptance And Action Questionnaire for Weight related difficulty
ESRD	End Stage Renal Disease
p	Probability

ABSTRACT

Background:

The World Health Organization (WHO) considers obesity to be one of the most serious public health challenges of the 21st century. The health risks of obesity are a forever growing concern for societies worldwide. Obesity has a negative impact on health and quality of life. From the perspective of both the individual and society, it is therefore essential to identify strategies for managing this problem**.** Studies shows that Shatkriyas had reduced lipid profile and body weight. The aim of this review was to systematically assess and analyze the effects of Shatkriyas on weight- related outcomes. The present Pre and Post experimental study was planned to evaluate the effect of Laghoo shankaprakshalana on lipid profile and anthropometric measurements in obese individuals.

Methods:

A total of forty subjects, mean aged (Male 22.33± 1 & female28.87 ± 6.2) were assigned into study after satisfying the inclusion and exclusion criteria. Subjects were assessed at baseline and after 8 weeks for lipid profile like Total cholesterol, Triglycerides, Very Low density Lipoprotein(VLDL), High Density Lipoprotein(HDL), Low Density Lipoprotein(LDL), and waist hip ratio. During these 8 weeks the subjects were practiced Laghoo Shankaprakshalana once a week.

Results:

Sample paired t test showed that study group had significantly improved in lipid profile and there is reduction in body weight , Body Mass Index and Waist Hip ratio. Therefore, Post-test data clearly indicates that there is a significant difference of BMI and waist & Hip Ratio,lipid profile than the pre-test data.

Key words: Obesity; shatkriya;Laghooshankaprakshalana; Lipid profile; Anthropometric measurements.

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1.0 INTRODUCTION

Obesity is defined as abnormal or excessive fat accumulation that may impair health.(1) It is chronic and multi-factorial disease and one of the most important causes of morbidity and premature mortality seen worldwide obesity and overweight.(2)

WHO reports that in 2016, more than 1.9 billion adults aged 18 years and older were overweight. Out of these over 650 million adults were obese. In 2016, 39% of adults aged 18 years and over (39% of men and 40% of women) were overweight. Overall, about 13% of the world's adult populations (11% of men and 15% of women) were obese in 2016. The worldwide prevalence of obesity nearly tripled between 1975 and 2016. Overweight and obesity are linked to more deaths worldwide than underweight. Globally there are more people who are obese than underweight. The impact of obesity has been considerable in both developed and developing countries.

According to a WHO report, obesity has been identified as a major cause of disability and premature deaths in less developed countries. This has been attributed to shifts in diet and lifestyle modification(1).The risk of many diseases including cardiovascular diseases (CVDs), hypertension, hyperlipidemia, diabetes mellitus, and certain cancers increases numerous folds in association with obesity. It has been estimated that obesity accounts for 2% to 7% of total healthcare costs. There are also other costs to consider such as reduced quality of life and productivity loss attributed

to medical leave.(3) It has been estimated that the global burden attributable to increased BMI were 12% for colon cancer, 8% for postmenopausal breast cancer and 32% for endometrial cancer in women.(4)

In terms of diabetes, it has been estimated that 64% of cases of diabetes in men and 77% of cases in women can be attributed to excess weight gain. The same is true for 33% of ischaemic heart disease and ischaemic strokes, 50% of hypertensive disease and 25% of osteoarthritis.(5)

Non-pharmacological approach to the prevention and treatment of obesity includes considerable lifestyle changes such as adequate physical exercise, smoking cessation, limiting alcohol intake, avoiding sedentary lifestyles, intensive behavioral counseling (psychotherapy), proper nutritional (dietary) programs, and bariatric surgery. Bariatric surgery is the most effective treatment for obesity when the other forms of intervention have failed to produce a clinically significant weight loss in individuals with a BMI of ≥35 kg/m2. For a pharmaco-therapeutic substance to be regarded as an anti-obesity drug, it has to demonstrate a reduction of at least 5%–10% in the baseline body weight within a year of commencing treatment. All anti-obesity drugs should be prescribed with the premise of dietary caloric restriction and exercise and dictated by patient comorbidities, relative contraindications, available clinical trial evidence, and most importantly clinical expertise.

Concerning the prospective future research directions on the pharmacotherapy of obesity, a number of initiatives have been put forward to develop a peripherally restricted CB1 receptor antagonist that target only the peripheral CB1 receptors by

restricting their ability to cross the blood–brain barrier in order to avoid the serious and severe psychiatric adverse effects found to be associated with the unrestricted CB1 receptor antagonists such as rimonabant.

Finally, nonadrenergic peptides such as orexin A, irisin, metorin, FGF 21, natriuretic peptides, and transcription factor PRDM16 are currently important novel targets in the pharmacotherapy of obesity.(6)

There are many CAM (complementary and alternative systems of medicine) therapies that include both pharmacological and non-pharmacological therapies, some of them with highly evolved philosophical basis that differ from the philosophy of modern medicine. These CAM systems that are widely practiced in different geographical areas include *āyurveda,* Homeopathy, Traditional Chinese system of medicine, Unani, *Siddhā,* Naturopathy, *Yoga,* etc. There are many publications that have shown the efficacy of some of these some of these complimentary tools to manage non-communicable diseases in general and obesity in particular.(6)

According to Sage Patanjali, Yoga is defined as **"Yogahchittavrttinirodhah"** yogah - yoga; chitta - consciousness; vrtti - patterns or circular patterns; nirodhah - blocking, stopping. "To balance the patterns of consciousness is yoga. It is totally restraints of complete cessation of mental fluctuations of mind".(7)

Yoga plays a significant role in enhancing one's physical as well as psychological health.

Of the many authorities on hatha yoga, one outstanding personality is Swatmarama who compiled the *Hatha Yoga Pradipika***.** It can also be translated as 'Light on Hatha

Yoga.' However, the term *pradipika* actually means 'self-illuminating' or 'that which illumines.'

It is a text which illumines a multitude of physical, mental and spiritual problems for aspirants.(8) Therefore, Shatkarma comes first, i.e. neti, dhauti, basti, kapalbhati, trataka and nauli. Hatha yoga begins with these practices. In order to purify the mind, it is necessary for the body as a whole to undergo a process of absolute purification. Hatha yoga is also known as the science of purification, not just one type of purification but six types. The body has to be cleaned in six different ways for six different impurities.

When you clear the body of these impurities, the nadis function and the energy blocks are released. Hatha yoga is famous for these six cleansing techniques. Although only six in number, each has a variety of practices. **"Shatkarma"** *Shat* means 'six' and *karma* means 'action'; the shatkarmas consist of six groups of purification practices. *Dhauti*is divided into four parts. According to the *Gherand Samhita* they are called *antar*(internal) *dhauti, danta*(teeth) *dhauti, hrid*(cardiac) *dhauti* and *moola shodhana*(rectal cleaning). In that sense, *Yogic kriyās* refer to special techniques meant to cleanse the inner organs.

The aim of hatha yoga and, therefore, of the shatkarmas is to create harmony between the two major pranic flows, ida and pingala, thereby attaining physical and mental purification and balance. They produce the following effects Activating & revitalizing the organs,Toning up their functions, Desensitization, Development of deep internal awareness.(9)

Shatkarmas are also used to balance the three doshas or humours in the body: *kapha,* mucus; *pitta,* bile; and *vata,* wind. *These are known as shatkarma or the six cleansing processes.* Among several *kriyās* available in the *yogic* lore 6 major *kriyās* are called *śatkriyās* are quite comprehensive. Antar dhauti is divided into four practices**:** *vatsara dhauti,* expelling air through the anus, *varisara dhauti,* evacuating a large quantity of water through the bowels, *vahnisara dhauti,* rapid expansion/contraction of the abdomen, *bahiskrita dhauti,* washing the rectum in the hands.

Varisara dhauti is more commonly known today as *shankhaprakshalana*.(10) In this practice you drink a total of sixteen glasses of warm salty water and evacuate it through the bowels. *Shankhaprakhsālana*is a *yoga* practice (*kriya*) recommended for cleansing the bowel. *Laghu shankhaprakshālana* (LSP) is a simplified version of this *kriya* that is completed in a shorter time and offers lesser physical strain.

The commentator of *haṭhayogapradipika, Swami Muktabodhananda,* he correlated the *varisāra dhauti* to śankhaprakśālana.(10) *Vārisāra dhauti*is said to be the highest *dhauti* and one who practices it with ease, purifies his filthy body and turns it into a shining one. Therefore, yoga may be a core primary or adjunctive clinical therapy for obesity and risk-reduction or prevention of associated diseases.(11)

Studies says that yoga practices decreases BMI, waist hip ratio, total cholesterol, VLDL, triglycerides and an increase in HDL cholesterol(12) and also states that Shatkarma practices significantly reduce the Serum Glucose and Serum Cholesterol of the practitioners.(13)

Previous study shows that *Vaman Dhauti Karma* technique helps in cleansing the digestive system from the stomach to the mouth, preventing indigestion, obtaining the best possible assimilation of nutrients into the body as well as eliminating other digestive ailments, and through this way it can reduce obesity and related disorders.(14) *Laghu ShankhaPrakshalana (LSP)* also reduces the bile acid pool resulting in reduced fat and thus it can help to reduce weight.(15) Yoga based colon cleansing (LSP) have beneficial effects immediately after the practice in patients with Chronic Low back pain.(9)

We observed that case of obesity is remarkably increasing in our outpatient department. Moreover, there is lack of insight on obesity and laghoo shankaprakshalana, we have conducted this study with larger sample size and rigorous methodology to evaluate the effect of Laghoo shankaprakshalana in obese subjects.

2.0. AIMS AND OBJECTIVES

2.1.AIM

To evaluate the effect of laghoo shankaprakshalana on lipid profile and anthropometric measurements in obese individuals.

2.2. OBJECTIVES OF THE STUDY:

Primary Objective:

To evaluate the effect of laghoo shankaprakshalana in obese individuals on lipid profile.

- Total cholesterol
- Triglycerides
- Very Low Density Lipoprotein(VLDL)
- High Density Lipoprotein(HDL)
- Low Density Lipoprotein(LDL)

Secondary Objective:

To assess the effect of laghoo shankaprakshalana in obese persons on anthropometric measurements.

- Height and Weight
- BMI
- Waist Circumference
- Hip Circumference
- Waist Hip Ratio

3.0 REVIEW OF LITERATURE

3.1 OBESITY

Obesity, which is generally defined as excess body weight for a given height, remains a continuing worldwide health concern, as it is related with increased risk of numerous chronic diseases including type 2 diabetes (T2D), hypertension and cardiovascular disease (CVD). The pathogenesis of obesity is multifaceted, with environmental, socio-cultural, physiological, medical, behavioral, genetic, epigenetic, and numerous other factors contributing to causation as well as persistence.(16) According to the World Health Organization (WHO), obesity is classified as class I for a BMI between 30 and 34.9 kg/m^2, class II for a BMI between 35 and 39.9kg/m^2 and class III for a BMI≥40kg/m^2.(1) In turn, class I obesity is associated with(hence, labeled as) a "moderate risk", class II with a "high risk", and class III with a "very high risk" of mortality.(17)

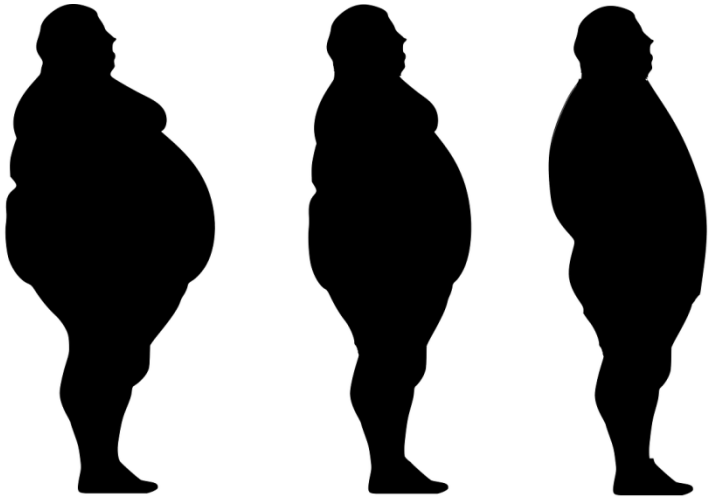


Figure 1: Obesity

Obesity is recognized as excess accumulation of fats (Resulting in increased weight). Obesity is most generally caused by a combination of excessive food intake, lack of physical activity, and genetic susceptibility. The incidence of obesity worldwide is increasing caused mostly by genes, endocrine disorders, medications. One important category of obesity not captured by BMI is so-called “abdominal obesity”-the extra fat found around the middle that is an important factor in health, even independent of BMI.

3.1.1 PREVALENCE

Globally, there are 1.5 billion adults who are either overweight or obese, a number expected to increase to 3 billion by 2030. Obesity in India has reached epidemic proportions in the 21st century, with morbid obesity affecting 5% of the country's population. India is following a trend of other developing countries that are steadily becoming more obese. Obesity is a major risk factor for cardiovascular disease and metabolic disorders. In addition to inadequate eating habits, a sedentary lifestyle is the main cause of obesity. The point prevalence is higher in women (15%) than in men (11%).(18)

3.1.2 CAUSES OFOBESITY

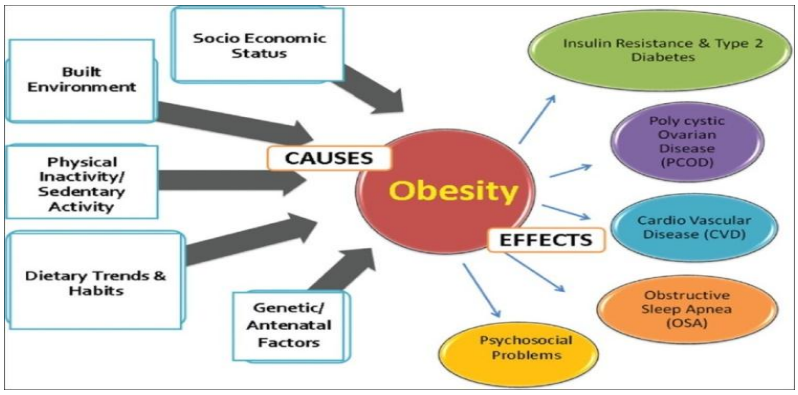


Figure: 2: Causes and effects of obesity

The balance between calorie intake and energy expenditure determines a person's weight. If a person eats more calories than he or she burns (metabolizes),the person gains weight (the body will store the excess energy as fat). If a person eats smaller quantity calories than he or she metabolizes, he or she will lose weight. Therefore the most common causes of obesity are overeating and physical inactivity. Therefore, body weight is the result of genetics, metabolism, environment, behavior, and culture.

Genetics

A person is more likely to develop obesity if one or both parents are obese. Genetics also affect hormones involved in fat regulation. For example, one genetic cause of obesity is leptin deficiency. Leptin is a hormone produced in fat cells and also in the placenta. Leptin controls weight by signaling the brain to eat less when body fat stores are too high.

Overeating

Overeating leads to weight gain, especially if the diet is high in fat. Foods high in fat or sugar (for example, fast food, fried food, and sweets) have high energy density (foods that have a lot of calories in a small amount of food).Epidemiologic studies have shown that diets high in fat contribute to weight gain.

A diet high in simple carbohydrates

The role of carbohydrates in weight gain is not clear. Carbohydrates increase blood glucose levels, which in turn stimulate insulin release by the pancreas, and insulin promotes the growth of fat tissue and can cause weight gain. Some scientists believe that simple carbohydrates (sugars, fructose, desserts, soft drinks, beer, wine, etc.) contribute to weight gain because they are more rapidly absorbed into the bloodstream than complex carbohydrates (pasta, brown rice, grains, vegetables, raw fruits, etc.) and thus cause a more pronounced insulin release after meals than complex carbohydrates. This higher insulin release, some scientists believe, contributes to weight gain.

Frequency of eating

There are many reports of overweight people eating less often than people with normal weight. Scientists have observed that people who eat small meals four or five times daily, have lower cholesterol levels and low and or more stable blood sugar levels than people who eat less frequently.

One possible explanation is that small frequent meals produce stable insulin levels, whereas large meals cause large spikes of insulin after meals.

The primary sources of these extra carbohydrates are sweetened beverages, which now account for almost(19)percent of daily food energy in young adults in America(20) and potato chips.(21)Consumption of sweetened drinks such as soft drinks, fruit drinks, iced tea, and energy and vitamin water drinks is believed to be contributing to the rising rates of obesity.(22)

Physical inactivity

Sedentary people burn fewer calories than people who are active. The National Health and Nutrition Examination Survey (NHANES) showed that physical inactivity was strongly correlated with weight gain in both sexes.

Medications

Medications associated with weight gain include certain antidepressants(medications used in treating depression), anticonvulsants (medications used in controlling seizures such as carbamazepine and Valproate, some diabetes medications (medications used in lowering blood sugar such as insulin, sulfonylureas, and thiazolidinediones), certain hormones such as oral contraceptives, and most corticosteroids such as prednisone.

Weight gain may also be seen with some high blood pressure medications and antihistamines. The reason for the weight gain with the

medications differs for each medication. If this is a concern for you, you should discuss your medications with your physician rather than discontinuing the medication, as this could have serious effects.

Psychological factors

Emotions influence eating habits. Many people eat excessively in response to emotions such as boredom, sadness, stress, or anger. While most overweight people have no more psychological disturbances than normal weight people, about 30% of the people who seek treatment for serious weight problems have difficulties with binge eating. Diseases such as hypothyroidism, insulin resistance, polycystic ovary syndrome, and Cushing's syndrome are also contributors to obesity.

Social issues

A link between social issues and obesity has been established. Lack of money to purchase healthy foods or lack of safe places to walk or exercise can increase the risk of obesity.

3.1.3PATHOPHYSIOLOGY OF OBESITY:

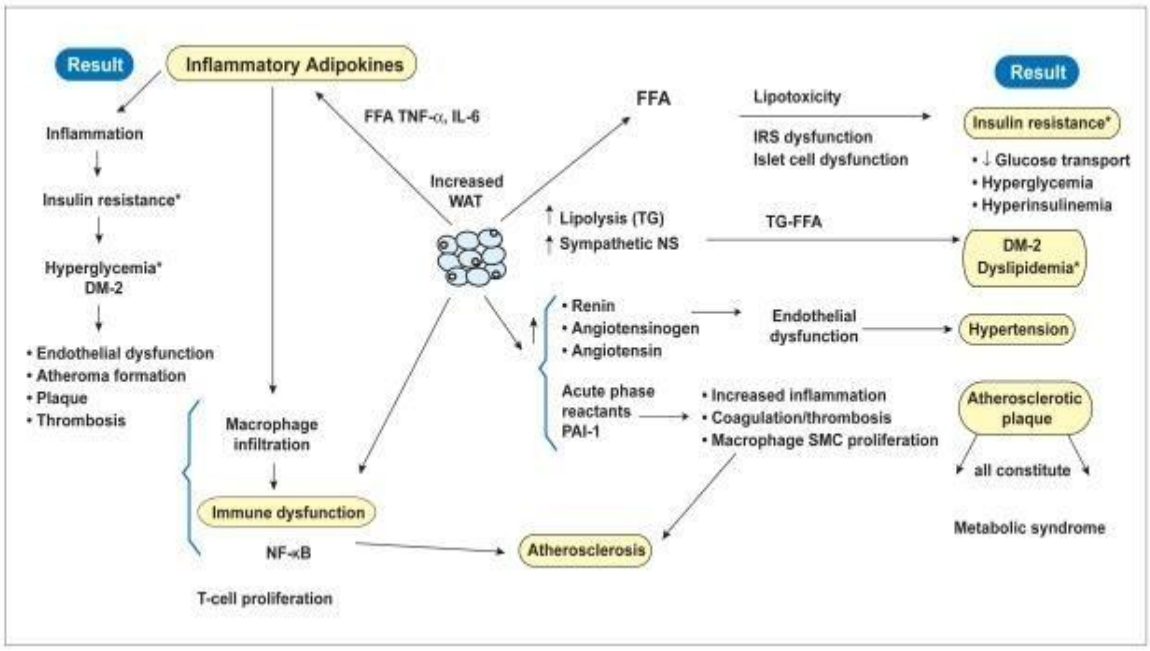


Figure 3: Pathophysiology of Obesity

Adipose tissue is a heterogeneous mix of adipocytes, stromal pre adipocytes, immune cells, and endothelium, and it can respond rapidly and dynamically to alterations in nutrient excess through adipocytes hypertrophy and hyperplasia.(23)With obesity and progressive adipocytes enlargement, the blood supply to adipocytes may be reduced with consequent hypoxia.(24)Hypoxia has been proposed to be an inciting etiology of necrosis and macrophage infiltration into adipose tissue that leads to an overproduction of biologically active metabolites known as adipocytokines which includes glycerol, free fatty acids (FFA), pro inflammatory mediators (tumor necrosis factor alpha (TNF α) and

interleukin-6 (IL-6)), plasminogen activator inhibitor-1 (PAI-1), and C-reactive protein (CRP).(25)

This results in a localized inflammation in adipose tissue that propagates an overall systemic inflammation associated with the development of obesity related comorbidities.(26)Adipocytokines integrate the endocrine, autocrine, and paracrine signals to mediate the multiple processes including insulin sensitivity(27), oxidant stress(28), energy metabolism, blood coagulation, and inflammatory responses(29), which are thought to accelerate atherosclerosis, plaque rupture, and atherothrombosis. This shows that the adipose tissue is not only specialized in the storage and mobilization of lipids but it is also a remarkable endocrine organ releasing the numerous cytokines.

3.1.4 DIAGNOSTIC CRITERIA

The key anthropometric measurements are important to evaluate the degree of obesity—weight, height, BMI, waist circumference, hip circumference, waist hip ratio.

Body Mass Index (BMI) The body mass index (BMI), calculated as **weight (kg)/height (m)** ^{2}**,** or as **weight (pounds)/height (inches)** ^{2} **x 703,** is used to classify weight status and risk of disease. BMI is used since it provides an estimate of body fat and is related to risk of disease. Lower BMI thresholds for overweight and obesity have been proposed for the Asia-Pacific region since this

population appears to be at-risk at lower body weights for glucose and lipid abnormalities.

BMI = Body Weight (in kilograms) / Height (in square meter)

Overweight	**≥ 25.00**	**≥ 25.00**
Pre-obese	25.00 – 29.99	25.00 – 27.49
		27.50 – 29.99
Obese	**≥ 30.00**	**≥ 30.00**
Obese Class I	30.00 – 34.99	30.00 – 32.49
		32.50 – 34.99
Obese Class II	35.00 – 39.99	35.00 – 37.49
		37.50 – 39.99
Obese Class III	**≥ 40.00**	**≥ 40.00**

Table 1: Classification of obesity

WAIST: HIP RATIO

Excess abdominal fat, assessed by measurement of waist circumference or waist-to-hip ratio, is independently associated with higher risk for diabetes mellitus and cardiovascular disease. Measurement of the waist circumference is a surrogate for visceral adipose tissue and should be performed in the horizontal plane above the iliac crest and Hip circumference was measured around the pelvis at the point of maximal protrusion of the buttocks. Cut points that define higher risk for men and women based on ethnicity have been proposed by the international diabetes foundation.(30)

Calculation of WHR = Waist circumference (cm) / Hip circumference (cm).

Ethnic group	Waist Circumference
Europid	≥94 cm (M), ≥80 cm (F)
Sub-Saharan African	≥90cm (M), ≥80 cm (F)
Eastern and Middle Eastern	
South Asian, Chinese	
South and Central America	
Japanese	≥90 cm (M), ≥80 cm (F)

Table 2: According to International Diabetes Foundation[53], Ethnic specific values of waist circumference. M-Male, F-Female

Waist-to-Hip Ratio (WHR) Norms				
Gender	Excellent	Good	Average	At Risk
Males	<0.85	0.85–0.89	0.90–0.95	>0.95
Females	<0.75	0.75–0.79	0.80–0.86	>0.86

Table 3: Criteria for waist/hip ratio in adults

Figure 4: Measurement of waist hip ratio

3.1.5 COMPLICATIONS

Obesity has major adverse effects on health. Increased mortality from obesity is primarily due to cardiovascular disease, hypertension, gall bladder disease, diabetes mellitus, and several types of cancer, such as cancer of the esophagus, colon, rectum, pancreas, liver, and prostate, and gallbladder, bile ducts, breasts, endometrium, cervix and ovaries in women. Sleep apnea in severely obese individuals poses serious health risk.

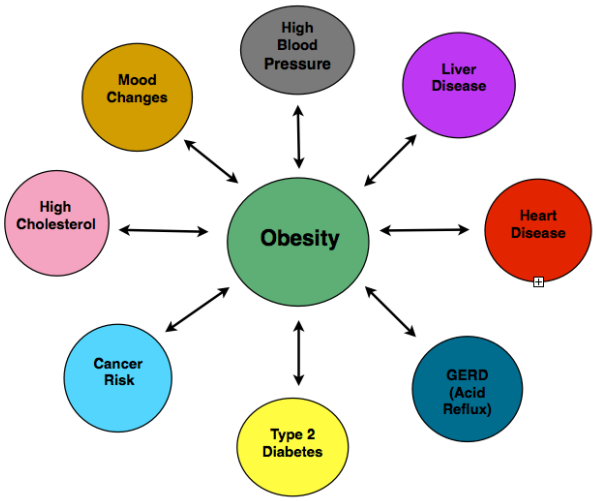


Figure 5. Complications of Obesity.

Obesity is also associated with an increased incidence of steatohepatitis, garstroesophageal reflux, osteoarthritis, gout, back pain, skin infections, and depression. Hypoganadism in men and infertility in box sexes are prevalent in obesity; in women this may be associated with polycystic ovarian syndrome.(31)

3.2 DYSLIPIDEMIA

Dyslipidemia is elevation of plasma cholesterol, triglycerides (TGs), or both, or a low HDL cholesterol level that contributes to the development of atherosclerosis. Causes may be primary (genetic) or secondary. Diagnosis is by measuring plasma levels of total cholesterol, TGs, and individual lipoproteins. Treatment involves lifestyle modification like dietary changes, exercise, and lipid-lowering drugs.

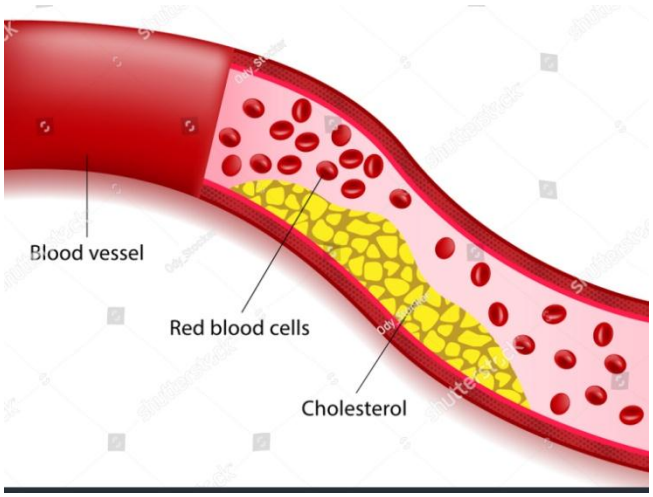


Figure 6: Showing Dyslipidimia

Dyslipidemia is a primary, major risk factor for CAD. Epidemiologic data also suggest that hypercholesterolemia and perhaps coronary atherosclerosis itself are risk factors for ischemic stroke.(32)

3.2.1 PREVALENCE

Lipid abnormalities are major risk factors for premature CAD. The prevalence of dyslipidemia was observed to be higher in males than in females. The increase of prevalence of hypercholesterolemia and hyper triglyceridemia was more prominentin 31-40 age group than in ≤ 30 age group.(33) Recent studies have reported that high cholesterol is present in 25–30% of urban and 15–20% rural subjects.

The most common dyslipidemia in India are borderline high LDL cholesterol, low HDL cholesterol and high triglycerides. Studies have reported that over a 20-yearperiod total cholesterol, LDL cholesterol and triglyceride

levels have increased among urban populations.(34)

3.2.2 Operational Definition

The diagnosis of dyslipidemia will be based on the alterations in the levels of Total cholesterol (TC), LDL-cholesterol (LDL-C), HDL-cholesterol (HDL-C) and total triglycerides (TGs).

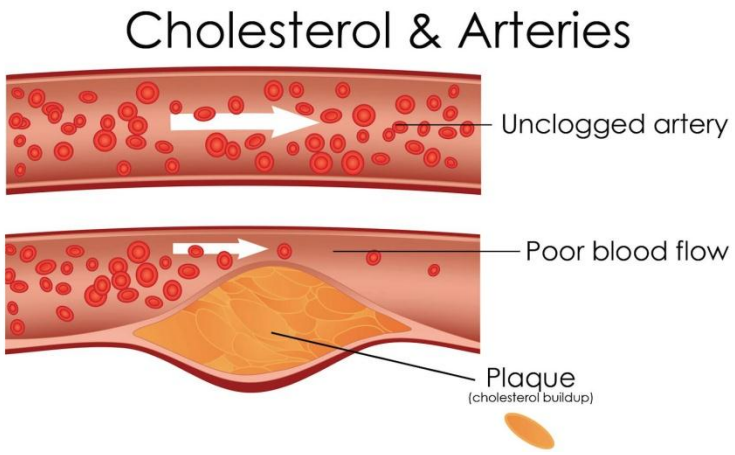


Figure 7: Accumulation of cholesterol in artery

3.2.3 ETIOLOGY

Dyslipidemias may be

- Primary: Genetic
- Secondary: Caused by lifestyle and other factors

Both primary and secondary causes contribute to dyslipidemias in varying degrees.

Primary causes

Primary causes are single or multiple gene mutations that result in either overproduction or defective clearance of triglycerides and LDL, or in underproduction or excessive clearance of HDL Genetic (Primary) Dyslipidemias). The names of many primary disorders reflect an old nomenclature in which lipoproteins were detected and distinguished by how they separated into alpha (HDL) and beta (LDL) bands on electrophoretic gels.

Secondary causes

Secondary causes contribute many cases of dyslipidemia in adults. The most important secondary cause of dyslipidemia in developed countries is sedentary lifestyle with excessive dietary intake of saturated fat, cholesterol, and trans fats. Trans fats are polyunsaturated or monounsaturated fatty acids to which hydrogen atoms have been added; they are used in some processed foods and are as atherogenic as saturated fat.

Other common secondary causes of dyslipidemia include

- Diabetes mellitus
- Alcohol overuse
- Chronic kidney disease
- Hypothyroidism
- Primary biliary cirrhosis
- Cholestatic liver diseases

- Drugs, such as thiazides, beta-blockers, retinoids, highly active antiretroviral agents, cyclosporine, tacrolimus, estrogen and progestins, and glucocorticoids

Secondary causes of low levels of HDL cholesterol include cigarette smoking, anabolic steroids, HIV infection, and nephrotic syndrome.(35)

3.2.4 PATHOPHYSIOLOGY OF DYSLIPIDIMIA

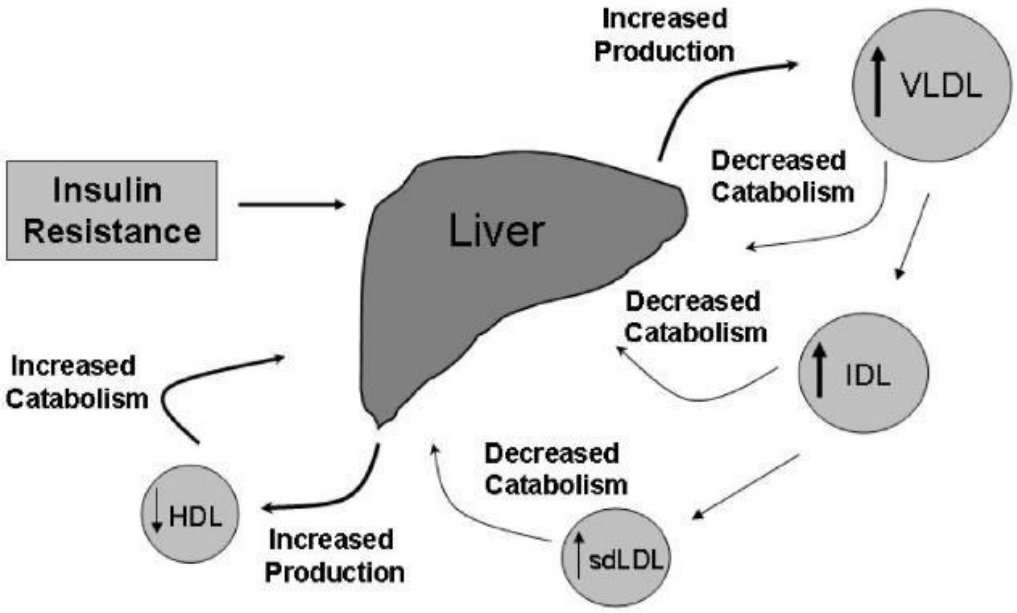


Figure 8: Pathogenesis of Dyslipidemia

Link between abdominal obesity and metabolic abnormalities

Regional body fat distribution has an important influence on metabolic and cardiovascular risk factors. Many prospective studies have shown that increased abdominal (visceral) fat accumulation is an independent risk factor for CAD,

hypertension, stroke, and type 2 diabetes (DM2).(36) The strong link between increased abdominal (visceral) fat and hyperinsulinism, insulin resistance, elevated plasma free fatty acid (FFA) levels, hypertension, predisposition to thrombosis, hypertriglyceridemia, small, dense LDL particles, and reduced HDL has been recognized for decades, but until recently there has been no uniform definition of this disease complex.

The National Cholesterol Education Program (NCEP) and others have recently suggested the use of the term metabolic syndrome to identify the common cluster of metabolic abnormalities, defined as three or more of five criteria: 1) abdominal obesity (waist circumference, >102 cm in men and >88 cm in women), 2) hypertriglyceridemia [≥1.69 mmol/liter (≥150 mg/dl)], 3) low HDL <1.04 mmol/liter (<40 mg/dl) in men and <1.29 mmol/liter (<50 mg/dl) in women], 4) hypertension (≥130/85 mm Hg), and 5) elevated fasting glucose [≥6.1 mmol/liter (≥110 mg/dl)].(37) Even normal weight individuals with increased amounts of abdominal adipose tissue can be metabolically obese, with insulin resistance and dyslipidemia.(38)

Multiple environmental and genetic factors are thought to influence the manifestation of abdominal obesity. Intra abdominal fat increases with age in both overweight and normal weight individuals independently of changes in total body fat.(39) Sex steroid hormones appear to contribute to body fat distribution, as men have twice as much abdominal fat as women (40) and estrogen

deficiency (at menopause) is associated with a preferential increase in intra abdominal fat, which is blunted by estrogen replacement therapy.(41)

There is also evidence that increased abdominal adipose tissue is associated with physical inactivity, increased plasma cortisol and intrauterine environment.(42) Inheritance clearly plays a role in body fat distribution, as family studies have shown that genetic factors account for about 50% of the variance in intra abdominal fat after adjusting for age, sex, and total body fat.(43) Genetic factors that predispose individuals to gain weight centrally may explain the susceptibility of certain ethnic groups to DM2.(44)

Dyslipidemia of abdominal adiposity

The increased focus on the metabolic syndrome has drawn attention to the identification and treatment of the dyslipidemia associated with abdominal fat accumulation. The changes in lipid metabolism seen with abdominal fat accumulation have been well characterized and include hypertriglyceridemia, reduced HDL cholesterol, and increased numbers of small, dense LDL particles. Elevated LDL cholesterol is not a feature of the dyslipidemia seen with abdominal obesity. Other features of the dyslipidemia of abdominal adiposity include elevated very low density lipoproteins (VLDL), and reduced HDL_2, which are the large buoyant antiatherogenic subspecies of total HDL. In some individuals, apo B levels may be elevated, reflecting an increase in the number of small, dense lipoprotein particles (VLDL and LDL).

The hypertriglyceridemia seen with abdominal obesity and insulin resistance is related to the over secretion of triglyceride-rich VLDL particles (see Fig. 1). An increased rate of hepatic FFA uptake stimulates the secretion of apo B-100, leading to increased numbers of apo B-containing particles and possibly hypertriglyceridemia.(45)Apo B is the structural protein of atherogenic lipoproteins, including VLDL, intermediate density lipoproteins (IDL), and LDL. Each of these lipoproteins contains one apo B molecule, and the plasma apo B level reflects the total number of atherogenic particles in the blood. VLDL particles are exposed to lipoprotein lipase in the peripheral circulation, which hydrolyzes the triglyceride in VLDL particles, generating FFA. Under normal conditions, these FFA are taken up by muscle and adipose tissue for energy use or storage. The resultant remnant particles are then processed by the liver to form LDL.

Elevated portal vein FFA levels (with insulin resistance) lead to an overproduction of apo B-containing particles. Apo B is the structural protein of atherogenic lipoproteins, including VLDL and IDL, and the apo B concentration reflects the total number of atherogenic particles in the blood. The metabolic syndrome is associated with increased numbers of small VLDL, IDL, and LDL particles, with a decreased triglyceride to apo B ratio compared with normal.

An increased number of small, dense LDL particles is a constant feature of the dyslipidemia of abdominal adiposity, as they are associated with insulin

resistance, intra abdominal fat, and hypertension.(46) LDL comprises a spectrum of particles that vary in size, density, chemical composition, and atherogenic potential. In conditions of elevated triglycerides, LDL particles become enriched in triglycerides and depleted of core cholesteryl esters.

Hepatic lipase then acts to hydrolyze these triglyceride-rich LDL, forming smaller, denser LDL particles. The presence of small, dense cholesterol-depleted LDL particles is associated with an increased risk of myocardial infarction (47) and worsened severity of CAD.(48) The Familial Atherosclerosis Treatment Study showed that the strongest predictor of coronary artery stenosis regression, induced by aggressive lipid lowering, was the increase in LDL buoyancy, not the change in LDL cholesterol level.(49)

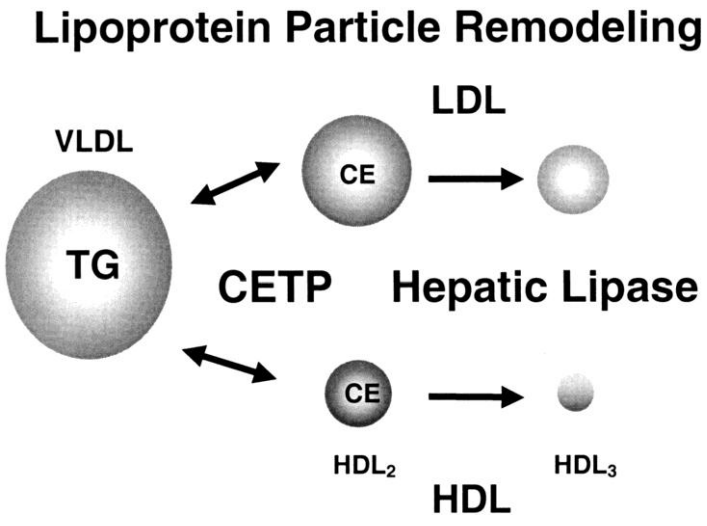


Figure 9: Exchange of cholesterol ester in Triglycerides

Cholesteryl ester transfer protein (CETP) facilitates the exchange of cholesterol ester in LDL and HDL particles for triglyceride in VLDL particles. The transfer of triglyceride into LDL and HDL particles makes them triglyceride-rich and hence a better substrate for hepatic lipase. Elevated hepatic lipase activity leads to a predominance of small, dense LDL particles and a reduction in HDL_2, the more antiatherogenic subspecies of HDL.

Although the mechanisms underlying the association of small, dense LDL with increased risk of CAD are not clear, several hypotheses have been proposed. One explanation is that the presence of small, dense LDL particles is a marker of an atherogenic lipoprotein phenotype comprised of elevated triglycerides, reduced HDL, and elevated apo B, which together increase CAD risk. Mechanistically, small, dense LDL particles enter the arterial wall more easily(50), bind to arterial wall proteoglycans more avidly , and are highly susceptible to oxidative modification, leading to macrophage uptake (51), all of which may contribute to increased atherogenesis.

HDL and VLDL metabolism are closely linked, which explains why increased plasma triglyceride is almost always associated with reduced HDL levels. Cholesteryl ester transfer protein mediates the exchange of triglyceride in VLDL for cholesteryl ester in LDL and HDL, leading to the production of triglyceride-rich LDL and HDL particles. Subsequent hepatic lipase-mediated

hydrolysis of these particles leads to the generation of small, dense LDL particles and a decrease in HDL_2 cholesterol.

3.2.5 CLASSIFICATION

Dyslipidemia was traditionally classified by patterns of elevation in lipids and lipoproteins. A more practical system categorizes dyslipidemia as primary or secondary and characterizes them by

- Increases in cholesterol only (pure or isolated hypercholesterolemia)
- Increases in TGs only (pure or isolated hypertriglyceridemia)
- Increases in both cholesterol and TGs (mixed or combined hyperlipidemia)

This system does not take into account specific lipoprotein abnormalities (eg, low HDL or high LDL) that may contribute to disease despite normal cholesterol and TG levels.

3.2.6 CURRENT INTERVENTION FOR DYSLIPIDIMIA

The treatment of the dyslipidimia of the metabolic syndrome should be focused on lowering LDL and apo B and increasing HDL. Statin treatment has been shown to reduce cardiovascular events in persons with low LDL cholesterol levels at baseline .(52) The percent reduction in LDL cholesterol and apo B by statin medications is similar, but apo B may be a better maker of treatment efficacy in metabolic syndrome patients with normal LDL cholesterol.(53)

Although LDL cholesterol has remained the primary target of lipid-lowering therapy, raising HDL levels is now an important secondary target to reduce CAD risk.(5) Combination lipid-lowering therapy is frequently needed to treat the dyslipidemia of the metabolic syndrome (increased triglyceride, reduced HDL, and small, dense LDL particles), if lifestyle changes (weight loss and exercise) are inadequate. Nicotinic acid and fibric acid derivatives both act to reduce triglyceride and increase HDL cholesterol.

They are frequently used with statin medications. Although fibrate mono therapy lowers plasma triglyceride levels, it can lead to increases in LDL levels. Bile acid resin binders lower LDL cholesterol levels, but can increase triglyceride levels in individuals susceptible to hypertriglyceridemia. Although niacin is an inexpensive mono therapeutic agent that corrects the dyslipidemia of the metabolic syndrome, it may increase glucose levels in some patients.(54)

3.2.7 DIAGNOSTIC CRITERIA

The measurement is important to evaluate the degree of dyslipidemia –Lipid Profile.

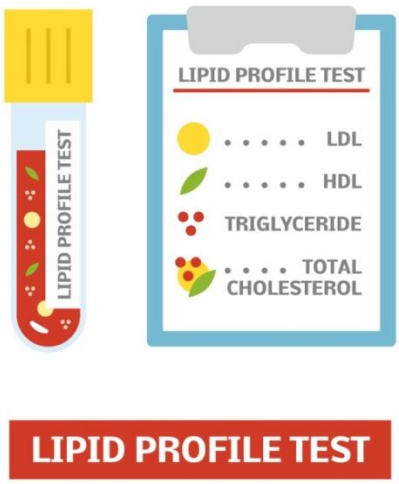


Figure 10: Lipid Profile Test

LIPID PROFILE

Lipid profiles are commonly used in the routine evaluation of cardiovascular risk, given the high correlations of hypercholesterolemia and hyper triglyceridemia and cardiovascular risk. A standard lipid profile includes determination of serum or plasma total cholesterol (TC), high-density lipoprotein-associated cholesterol (HDL-C),Very low density lipoprotein – associated cholesterol (VLDL), low-density lipoprotein-associated cholesterol (LDL-C), and total triglycerides (TGL).

Blood specimens should be collected after an overnight fast of 10–12 hours. This ensures that chylomicrons are cleared from plasma. In serum, the majority of cholesterol exists as cholesterol ester. Therefore, in the first step cholesterol ester is hydrolyzed by cholesterol ester hydrolase enzyme. Then cholesterol is oxidized by cholesterol oxidase, generating cholest-4-en-3-one and hydrogen peroxide. Hydrogen peroxide generated is proportional to serum cholesterol concentration and is measured by its reaction with a suitable compound, for example, 4- aminoantipyrene (reaction catalyzed by peroxidase) to form a colored dye. HDL is usually measured as HDL cholesterol after precipitating out other lipoprotein fractions using poly anions such as dextran sulfate-magnesium chloride, phospho- tungstate-magnesium chloride or heparin sulfate-manganesechloride.

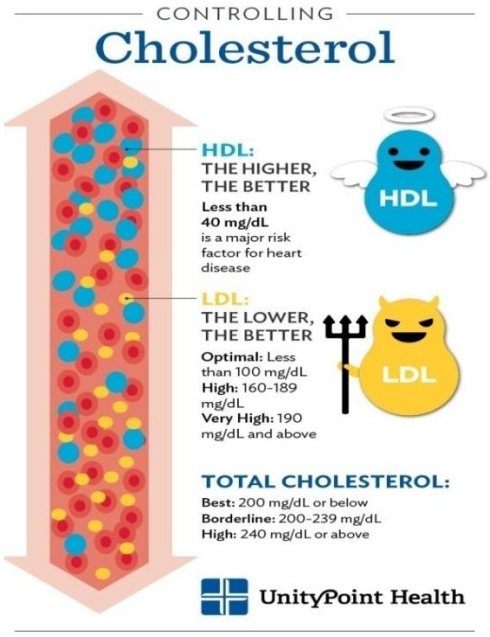


Figure 11: Components of cholesterol

For serum triglyceride measurement, lipase enzyme is used, which converts triglyceride into glycerol and free fatty acid. Then glycerol is oxidizedby glycerokinase into glycerophosphate. Glycerophosphate is then measured by either its reaction with nicotinamide adenine dinucleotide to form NADH or its oxidation by glycerophosphate oxidase enzyme, generating dihydroxyacetone and hydrogenperoxide. Plasma LDL values are typically calculated with the Friedewald formula:

LDL = Total cholesterol - [HDL cholesterol+ (Triglyceride/5)]

VLDL = Triglyceride/5

All measurements are in mg/dL. This formula is invalid if triglycerides values are above 400 mg/dL. In such situations direct measurement of LDL is indicated. In addition, this is only applicable for calculating LDL cholesterol in an overnight fasting specimen.(55)

NORMAL VALUES OF LIPID PROFILE

- **Total cholesterol:** Levels below 200 mg/dL (5.2 mmol/L)
- **Triglycerides:**Levels below 150mg/dL
- **LDL cholesterol:** Levels below 100 mg/dL (3.4 mmol/L)
- **HDL cholesterol:** Levels above 40 mg/dL (1 mmol/L) in men and above 50 mg/dL (1.3 mmol/L) in women.(56)

In addition to insufficient eating habits, a sedentary way of life is the major cause of obesity.(57) The prevalence is higher in women(15%) than in men(11%).(58) Management of obesity can include lifestyle changes, medications, or surgery. The main treatment for obesity consists of dieting and Yoga.

Yoga has a main role to take part in the treatment of Obesity. Yoga techniques affect body, internal organs, endocrine glands, brain, mind and other factors regarding Body-Mind complex. *Yoga* is a non-pharmacological self-corrective technique on a lifestyle of joy and satisfaction. It brings about an attitudinal change at the psychological level Various Yoga technique scan be practiced effectively to reduce the weight and achieve normal healthy condition of Body and Mind.

Yoga is a means of balancing and harmonizing the body, mind and emotions. From the physical body, yoga moves on to the mental and emotional levels. Yoga is merely a means of maintaining health and well-being in an increasingly stressful society.(59) The clue to right living is summarized in *bhagavatgitā*as; he who is moderate in food, activity, entertainment, sleep, and wakefulness attains *yoga* which destroys suffering.

॥ युक्त-आहार-विहारस्य युक्त-चेष्टस्य कर्मसु

युक्त-स्वप्न-अवबोधस्य योगः भवति दुःखहा ॥

॥ *yuktāhāravihārasya yuktaceṣṭasya karmasu,*

yuktasvapnāvabodhasya yogo bhavati duḥkhahā ॥

Saucha refers to "purity of body" and encourages "purity of mind". Purification is a central theme in yoga, along with empowerment, activation, and integration. As such it is abides at the first stage of yoga, but also at the last, simultaneously. The ancient Yogis developed the six cleansing techniques (Kriyas) for "purification" of the physical body. Shatkriyas are explained in classics of yogic science thousands of years ago in Hatha yoga Pradipika and Gheranda Samhita.

3.2.7 SHATKARMAS ACCORDING TO HATHA YOGA PRADEEPIKA

मेदश्लेष्माधिकः पूर्वं षट्कर्माणि समाचरेत् ।
अन्यस्तु नाचरेत्तानि दोषाणां समभावतः ॥२:२१॥

॥*Medashleshmaadhikahapoorvamshatkarmaanisamaacharet.*

Anyastunaacharettaanidoshaanaamsamabhaavataha॥

When fat or mucus is excessive, the shatkarmas or six cleansing techniques should be practised before (pranayama). Others, in whom the doshas (i.e. phlegm, wind and bile) are balanced, need not do them.(60)

Hatha Yoga Pradipika (2:21)

The aim of hatha yoga and, therefore, of the shatkarmas is to create harmony between the two major pranic flows, ida and pingala, thereby attaining physical and mental purification and balance.(61)

DHAUTI ACCORDING TO HATHA YOGA PRADIPIKA:

अत्र धौतिः ।

चतुरंगुलविस्तारं हस्तपंचदशायतम् ।
गुरूपदिष्टमार्गेण सिक्तं वस्त्रं शनैर्ग्रसेत् ।
पुनः प्रत्याहरेच्चैतदुदितं धौति कर्म तत् ॥ २४ ॥

A strip of wet cloth, four angulas wide (i.e. seven to eight centimeters) and fifteen hand spans (i.e. one and a half meters) in length is slowly swallowed and then taken out, as instructed by the guru. This is known as dhauti.(62)

The *Hatharatnavali* mentions the use of jaggery water or milk water (1.50) instead of salt water. There are also various other herbs and juices which could be used, such as a few drops of lemon, onion or garlic juice. Laghoo shankhaprakshalana could be done with carrot or celery juice.(62)

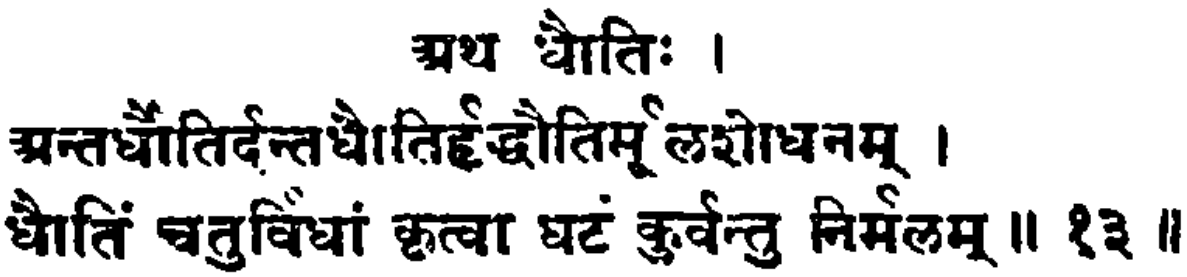
कासश्वासप्लीहकुष्ठं कफरोगाश्च विंशतिः ।
धौतिकर्मप्रभावेण प्रयांत्येव न संशयः ॥ २५ ॥

There is no doubt that coughs, asthma, diseases of the spleen, leprosy and twenty kinds of diseases caused by excess mucus are destroyed through the effects

of dhauti karma. The combination of all the practices of dhauti cleans the entire digestive tract and respiratory tract. It removes excess and old bile, mucus and toxins and restores the natural balance of the body's chemical composition, thus alleviating ailments caused by such imbalances. The results are a reduction of excess fatty tissue and relief from flatulence, constipation,

poor digestion and loss of appetite.(63)

ACCORDING TO GHERANDA SAMHITA



अथ धौतिः ।
अन्तर्धौतिर्दन्तधौतिर्हृद्धौतिर्मूलशोधनम् ।
धौतिं चतुर्विधां कृत्वा घटं कुर्वन्तु निर्मलम् ॥ १३ ॥

The dhauti are of four kinds and they clear away the impurities of the body. They are Antardhauti(internal washing), Dantadhuti (Cleansing the Tooth), Hrid dhauti (cardiac) and moolashodhana (rectal cleansing).

YOGA AND OBESITY

Priyanka Sharma et al stated the kriyas or purificatory exercises, help eliminate excess mucus, toxins, and impurities from the body. It is clear that the shat karmas are not simply physical cleansing exercises, rather they utilize specific bodily dynamics, evolutionary life functions, energetic and psychics mechanics in

order to remove emotional, mental, and energetic blockages and hindrances. They affect the physical body, the energy body, the mental/emotional body, the creative thought processes and the pathways of embodiment and relationship in a positive way.

Dhauti karma alleviates the Kapha disorders, hyperacidity, indigestion, obesity, bronchitis, asthma, cough, cold, bad breathe and others digestive problems. Enhance agni, lusture, nourishes body prevent and promote healthy state of body. Therfore shatkarma are beneficial for promotion of health as well as prevention of diseases.(64)

Sudhanshu verma et al concluded that the practice of kunjal kriya can helps the people suffering from obesity and obese. So finally it can be concluded that the practice of kunjal kriya can helps to manage obesity in corporate world.(65)

Pokhriyal KP Studies shows that the impact of the practice of Shatkarma practice showed a significant reduction on their serum glucose level and serum cholesterol level. In this pre- post research study a package of Shatkarma techniques (Kapalbhati - daily, JalaNeti - twice in a week and Vaman - once in a week) were introduced to them. They practiced Hatha Yoga regularly for 90 days under the guidance of a Yoga Expert except Sunday and holidays.(66)

The study conducted by Dr Kamathyakumar, Effect of Shatkarma practices on serum glucose and serum cholesterol level of the human subjects , an observation, the impact of the practice of Shatkarma showed a significance reduction on their serum glucose and serum cholesterol level.(67) To study the

safety and usefulness of adding *laghu śankhaprakśālana*to the integrated approach of *yoga* therapy in patients with essential hypertension.

There was a significant ($p<0.001$) reduction in Pulse rate, Systolic and Diastolic blood pressure immediately after both types of LSP with non-significant difference between the two sessions ($p<0.505$). There was significantly ($p<0.001$) more number of stools after LSP with *triphalā* water than LSP with plain water .Results of secondary variables after one week of intervention showed significant reduction in BMI ($p<0.004$), medications score ($p<0.001$), symptoms score ($P<0.001$), fatigue ($p<0.001$), state and trait anxiety scores (STAI, $P<0.001$) and scores on ill health (GHQ, $p<0.001$) with increase in duration of exhalation time ($p<0.001$), comfort level ($p<0.001$) and quality of sleep ($P<0.001$).

Study provides the first evidence that *laghu shankhaprakśālana kriyā* can be used safely to clear the bowel in patients with mild to moderate essential hypertension. Here, in our case this *kriyā* of LSP acts as a deep stimulation for the autonomic nervous system. When the participant lies down in *śavāsana* after LSP, he enters into a state of still deeper relaxation which leads to parasympathetic dominance and thereby reduction in BP.

Garg G studies concluded that Regular practice of *Shankhaprakshalana & Asana* does reduce blood sugar levels, the blood pres-sure, weight, the rate of progression to the complications, and the severity of the complications as well.(68)

Pokhriyal KP *concluded that Laghu Shankhaprakshalana* also reduces the bile acid pool. Bile is a complex fluid containing various substances, some of which are merely waste products undergoing excretion. Cholesterol, one of the chief constituents of bile, is also reduced; resulting in reduced fat (both triglyceride and cholesterol) absorption for the next several days (Malshe, 2005) and thus it can help to reduce weight.(66)

Tekur P concluded that Spinal flexibility was found better after LSP (*laghushankhaprakshalana*, a yogic colon cleansing technique) than BST (Back pain special technique) sessions in a self as control study on 40 in-patients between 25 and 70 years with CLBP. Deep relaxation is a powerful mind-body technique that works on the mental level by reducing agitation and quitting the mind, which in turn, reduces activity in the sympathetic nervous system while activating the parasympathetic system.(69)

Singh Daya Shankar et al, stated thatthe main purpose of Neti kriya is cleansing the head region and sensitizing the internal nadis and nerve of the nose, which are connected to the nadis of eyes. It is believed that the nadis related to sight and the inner parts of the nose are purified through the practice of Neti.(70)

Guruprasad K study on "Understanding Shatkarmas of Yoga through Ayurveda", it is beneficial for constipation, Irritable Bowel Syndrome, Diabetes, and all Gastro Intestinal Tract disorders, Relieves Flatulence, constipation. It counteracts the bowel malfunctioning that cause a decrease in the natural cleansing of the intestine due to low grade food, a sedentary life style, and gradual

organic brake down. If this is grossly observed it mimics Virechana karma, in this the medicated drugs will be given in the early morning, after which person passes loose stools for few times. This is better treatment for vitiated Pitta and Vatadosha hence by performing Laghu shankaprakshalana will get control over Vata and Pitta.(71)

M V Bhole Yoga Mimamsa, of Lonavala institute, who has investigated the influence of yogic techniques in normal and Asthmatic individuals, has reported the following findings. Neti and Kapalabhati directly influence the respiratory centers of the brain, by this powerful method voluntary influence on the brain activity, the patient gain the higher level of control over the movements of respiratory muscles, and the patterns of thought, feeling and general behavior. This is the fundamental in management and cure of Asthma in Yoga. Nethi Kriya cleanses nasal passages, releasing constructed upper airways and increasing the flow of breath, it should be routinely performed in the cases of Asthma.(72)

A Study conducted by Mushraf R. Sayyad adopting yoga therapy i.e. a set of yogasanas and shatkriya for symptomatic management, accepting balanced diet for weight management and use of traditional medicines, if necessary prove as an effective management of knee pain.(73)

The National Centre for Complementary and Alternative Medicine (NCCAM) refers to yoga as a ―mind-body medicine, with its use being recommended as a non- pharmacological tool for managing various non-

communicable diseases. Yoga which includes various postures (Asanas), breathing techniques (Pranayama), and meditation18 has been shown to have therapeutic benefits for individuals with a wide range of health conditions.

Obesity is a long-standing metabolic disorder caused by multiple factors, which can be traced back to 25,000 years ago, the earliest recorded in the Paleolithic statue. Now obesity has become one of the key causes of public health, with the rapid development of the global economy, the improvement of people's living standards, coupled with unreasonable dietary structure, bad lifestyle, etc.(74)

Halder K et al concluded that Hatha yoga can improve anthropometric characteristics, muscular strength and flexibility among volunteers of different age group and can also be helpful in preventing and attenuating age related deterioration of these parameters. Hatha yoga, an ancient Indian science of health and spirituality, facilitate the enrichment of health related quality-of-life to the practitioner by improving physical and mental health by balancing body, mind and emotions. With the practice of *asana*, *pranayama*, *mudra*, *bandha*, *shuddhi kriyas* and meditation Hatha yoga help in the improvement of all aspects of health and physical performance.(75)

Obesity is a common and preventable disease of clinical and public health importance. It is often a major risk factor for the development of several non-communicable diseases, significant disability and premature death. There is

presently a global epidemic of obesity in all age groups and in both developed and developing countries. The increasing prevalence of obesity places a large burden on health care use and costs. Weight loss is associated with significant health and economic benefits. Effective weight loss strategies include dietary therapy, physical activity and lifestyle modification etc. Obesity-A preventable disease increased risk of ill health and mortality than BMI alone. An abdominal girth in excess of 108 cm (40 inches) for men and 98 cm (35 inches) for women or a WHR > 1.0 and 0.85 in men and women, respectively, are the currently accepted indicators of excessive abdominal fat accumulation which correlate with a substantially increased risk of metabolic complications.(76)

Gadham et al observed a significant decrease in BMI, both systolic and diastolic blood pressures in subjects who were practicing yoga for a period of 3 months. Yoga and certain Asana's have beneficial effect on certain cardiovascular risk factors like obesity, hypertension and dyslipidemia.(16)

Tundwala V et al, concluded that there is significant improvement in various lipid profile parameters viz, decrease in total cholesterol, LDL, triglycerides, VLDL and increase in HDL in study group as compared to control group. It is concluded that the yoga and certain asanas have positive and useful effect on certain cardiovascular risk factors viz, obesity, hypertension and dyslipidemia.(77)

A Study conducted by K.V.V. PRASAD, The reduction in triglycerides and increase in HDL-cholesterol could be due to hydrolysis of TG-rich lipoproteins

that simultaneously replace intramuscular fat used during Pranayama and yogic practices. The present study had demonstrated the efficacy of Pranayama and Yogasanas on blood lipid profiles in normal healthy volunteers. Yoga practices may be helpful in patients with lipid metabolism disorders such as diabetes mellitus, coronary heart disease and dyslipidemia.(78)

Nautiyal R study establishes that one month regular practice of Surya namaskar helped obese persons to reduce their weight.(79) Another study concluded that Raja yoga meditation lowered serum cholesterol and low density lipoprotein - cholesterol in post-menopausal women thus reducing the risk of coronary artery disease in them.(80)

A study conducted by Prasad et al showed there was a significant decrease in TC, TG, LDL and VLDL in both men and women and significant increase in HDL in both genders which is in corroboration with the study carried out by BK Acharya et al.(81)

Kekan D concluded that in study group, by practicing kapalbhati pranayama-waist circumference and hip circumference decreased significantly as compared to that of control group. This shows that Kapalbhati pranayama has reducing impact on waist circumference and hip circumference in overweight individuals. The neuroendocrine and autonomic nervous system mechanisms might be involved in the effects of Kapalbhati pranayama, which need further study.(82)

Telles studies concluded that Yoga and nutritional advice with a diet plan can reduce anthropometric measures associated with diseases related to central

obesity, with more changes in the yoga. Yoga may be especially useful for adult females with central obesity between 30 and 45 years of age.(83)

Rshikesan PB studies shows that Improvement in anthropometric and psychological parameters such as Wt, Percentage body fat, PSS were observed in the final outcome. Also, some of the improvements such as AAQW score were lost in the final outcome, compared to interim results. The fat reduction was effective at central and peripheral parts in the Interim to Final result. Reduction of abdominal fat on male is correlated to reduction in perceived stress. The yoga practice is effective for obesity control for adult male in urban setting.(84)

Dadhe SS studies concluded that the Pranayama and exercise can BMI and Waist & Hip Ratio decrease significantly.(85) Cramer H et al conducted studies on 12-week yoga intervention had moderately strong positive effects on anthropometric and self-reported variables in women with abdominal obesity. Yoga is safe in this population and can be recommended as a technique for combating abdominal obesity in women.(86)

Riyaz Mohammed *et* al conducted 4 months of study has shown that patient enrolled in study group had mild decrease in BMI, and body weight which was not statistically significant but there was a significant reduction in total cholesterol, triglycerides and LDL cholesterol, apart from it, there was a non-significant elevation in HDL. Control group showed a significant increase in body weight. It was also noted that there was non-significant increase in total cholesterol,

triglycerides and a decrease in HDL. The bodyweight increase could be attributed to drugs like Sulphonylurea also.(87)

Robergs R Studies indicated that HDL-cholesterol was elevated in men with Pranayamam, while triglycerides and LDL-cholesterol decreased in women after yoga asanas. The results of the present study indicate that Pranayama and yoga asanas can be helpful in patients with lipid metabolism disorders such as coronary artery disease, diabetes mellitus and dyslipidemia etc.(88)

Gordon L et al studies demonstrate the efficacy of *Hatha Yoga* exercise on lipid parameters in ESRD patients. These findings suggest that *Hatha Yoga* exercise has preventive and beneficial effects and may be a safe therapeutic modality in ESRD patients. Optimal management of dyslipidemia in ESRD patients with regimens such as *Hatha Yoga* exercise, particularly reduction of low-density lipoprotein cholesterol, should therefore lead to both cardiovascular and renal benefits.(89)

Doddoli et al study concludes that yoga practices can effectively regulate lipid metabolism and total body energy expenditure with reference to specific constitutional type (*Prakriti*) that may act as a tool to assess magnitude of metabolic functions.(90)

Lee JA studies shows that yoga improves adiponectin level, serum lipids and metabolic syndrome risk factors in obese postmenopausal women. It is also very

effective in preventing cardiovascular disease caused by obesity in obese postmenopausal women.(91)

Studies conducted by Tapas Das et al concluded that Yoga therapy is beneficial in maintaining good health by regulating BMI, improving the biochemical functions of the body and helpful to overcome the complications of obesity and reduces the metabolic risk factors. This may have direct impact on the use of yoga therapy as a safe and cost effective therapeutic modality in combating metabolic syndrome and obesity.(92)

Mayor S et al studies shows that Yoga can significantly reduce cardiovascular risk factors including body mass index, blood pressure, and low density lipoprotein (LDL) cholesterol, says a systematic review that found it had similar benefits to aerobic activities such as cycling or brisk walking.(93)

Yank *et al.,* 2007 reviewed papers to determine the effects of yoga intervention on common risk factors of chronic diseases like overweight, hypertension, high glucose level and high cholesterol. A systematic search yielded 32 articles published between 1980 and April 2007. The study found that yoga interventions are generally effective in reducing body weight, blood pressure, glucose level and high cholesterol.(94)

Vijay T *et al.,* 2012 conducted study on effect of certain yogic postures and breathing techniques suggested that there is significant decrease in the parameters

of obesity mainly the Body Mass Index and Waist Hip Ratio.(95)

Littman *et al.,* 2012 showed that six month intensive yoga program on overweight and obesity breast cancer survivors can decrease waist circumference and improve quality of life.(96)

Braun *et al.,* 2012 suggested that *Kripalu yoga*-based, residential weight loss program suggests the psychological well-being, improved nutrition behaviors, and weight loss in obese individuals.(97)

DhananjaiS et al 2011 study indicates usefulness of yoga practices in reducing obesity and reduces risk factors associated with obesity and suggested the useful in management of obesity without any side effects.(98)

4.0 METHODOLOGY

The methodological process involved in the following study is described in detail in this chapter.

4.1 SUBJECTS

A total of 40 subjects of both genders with age group ranging between 18-40 years will participate in the study.

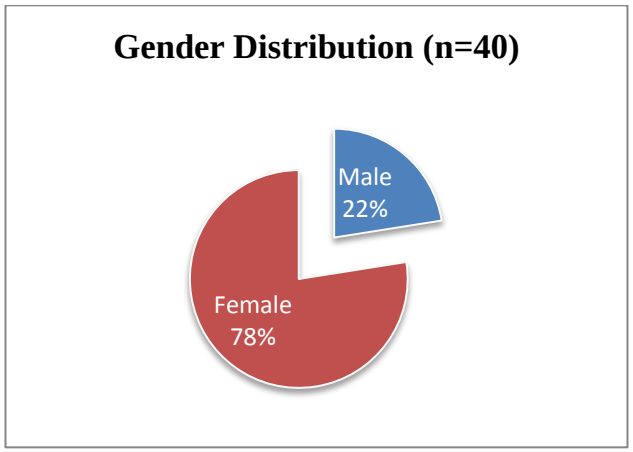


Figure 12: Gender Distribution

Total number of Patients enrolled in the study is 40.78% of the patients are Female and 22% of the patients are Male.

Demographic Data	Male	Female
Gender Distribution n=40)	**9**	31
Age(Mean±SD)	**22.33±1**	28.87±6.2
Age Range	**21-24**	21-37

Table 4:Showing Demographic Data

Total number of Patients enrolled in the study is 40.The average Age of the study patients is 22.33±1 % of the patients belongs to the Age group 21-24 years and 28.87±6.2 of the patients belongs to the Age group 21-37 years.

4.2 STUDY DESIGN

4.2.1 Type of design: A Single group pre and post experimental study.

4.3 SAMPLE SIZE

40 Obese persons of age group between 18 -40yrs will participate in the study. The subjects will be recruited from the Out – patient department of Government Yoga and Naturopathy Medical College Hospital, Chennai.

4.4 STUDY CENTRE:

Government Yoga and Naturopathy Medical College, Department of Yoga, Arumbakkam, Chennai-106.

4.5 DURATION OF THE STUDY

Duration of the entire intervention procedure:

Intervention period: 2 months

Frequency of practice: weekly once in a month for 2 months

Duration of practice: 1 hour

4.6 CRITERIA FOR DIAGNOSIS

4.6.1 Inclusion Criteria:

- BMI range from 30 to 40
- Age group: 18 to 40 years
- Both genders
- Known case of Dyslipidimia patients
- Persons who are ready to give their consent

4.6.2 Exclusion Criteria:

- Systemic disorders like respiratory, cardiac, renal, nervous, degenerative disorders.
- BMI above 40
- Below 18 years
- Under medication for chronic illness.
- Women during pregnancy and lactation

4.7 WITHDRAWAL CRITERIA

All subjects are free to withdraw from participation in the study at any time, for any reason, specified or unspecified, and without prejudice to further yogic practices. Subjects who are withdrawn from the study will not be replaced.

4.8 ASSESSMENTS OF PARAMETERS:

Lipid Profile (Triglycerides, LDL, VLDL, and HDL) will be done by using hematological test. A standard lipid profile includes determination of serum or plasma total cholesterol (TC), high-density lipoprotein-associated cholesterol (HDL-C),Very low density lipoprotein –associated cholesterol (VLDL), low-density lipoprotein-associated cholesterol (LDL-C), and total triglycerides (TGL). Plasma LDL values are typically calculated with the Friedewald formula:

LDL = Total cholesterol [HDL cholesterol + (Triglyceride/5)]

VLDL = Triglyceride/5

Sample Collection for lipid profile

After 12 hours of fasting, the blood was collected from antecubital vein before yogic practices, after 6 months, 1 year and 2 years of yogic practices. On the day of collection, the subjects were abstain from yogic practices and were in empty stomach. The time of blood collection was 7.00 to 8.00 am. The blood samples were collected in sterile bottles without anticoagulant and allowed to clot. The serum was analyzed for lipid profile. Serum Total Cholesterol (TC), Tri-glycerides (TGs), High density lipoprotein (HDL), Low density lipoprotein (LDL), Very low density lipoprotein (VLDL) were estimated by using auto analyzer.

According to American Heart Association Cholesterol > 200 mg/dl, Triglyceride value > 150 mg/dl, HDL cholesterol < 45 mg/dl, LDL cholesterol > 130 mg/dl and VLDL cholesterol > 40 mg/dl were defined as lipid disturbances.(81)

- Height (in centimeters) was measured using a stadiometer (SECA Model 214, SecaGmbh Co, Hamburg, Germany).
- Weight (in kilograms) was measured with an electronic weighing scale (SECA Model 807, SecaGmbh Co, Hamburg, Germany) that was kept on a firm horizontal flat surface.
- The body mass index (BMI), calculated as **weight (kg)/height (m) ^{2},** or as **weight (pounds)/height (inches) ^{2} x 703,** is used to classify weight status and risk of disease. BMI is used since it provides an estimate of body fat and is related to risk of disease.
- Waist Hip ratio (in centimeters) will be measured by using a non-stretchable measuring tape. Measurement of the waist circumference is a surrogate for visceral adipose tissue and should be performed in the horizontal plane above the iliac crest and Hip circumference was measured around the pelvis at the point of maximal protrusion of the buttocks. Cut points that define higher risk for men and women based on ethnicity have been proposed by the international diabetes foundation.(30)

Calculation of WHR = waist circumference (cm) / Hip circumference (cm).

4.9 ETHICAL CONSIDERATIONS

Ethical clearance

Ethical clearance was sought from the Institutional Ethics Committee prior to the start of the study and the approval for the same was granted.

Written informed consent

Subjects who fulfilled inclusion criteria were apprised about the purpose of the study and their rights as research subjects. Informed consent form was administered in English.

As all the subjects understood spoke English, there was no requirement of translating the signed informed consent form into native language i.e., Tamil. Adequate time was given to each patient to go through the information sheet and their queries were answered.

Their right to withdraw anytime from the study and the need for willingness to participate voluntarily in the study was explained. All the subjects expressed their willingness to participate in the study by giving a signed informed consent. (A sample information sheet and consent form is enclosed as Annexure 1)

Figure 13: Getting Informed Consent

4.10 METHODS OF COLLECTION OF DATA

The subjects will be taken into the study after taking anthropometric measurements. The subjects with BMI range from 30 to 40 will be taken into the study. Anthropometric parameters will be measured using standardized techniques. Height (in centimeters) was measured using a stadiometer. The individual will be asked to stand upright without shoes with his/her back against the vertical back board, heels together and eyes directed forward. Weight (in kilograms) will be measured with an electronic weighing scale that was kept on a firm horizontal flat surface. Subjects were asked to wear light clothing, and weight was recorded to the nearest 0.5 kg. Body mass index (BMI) was calculated using the formula weight (kg)/height $(m)^2$

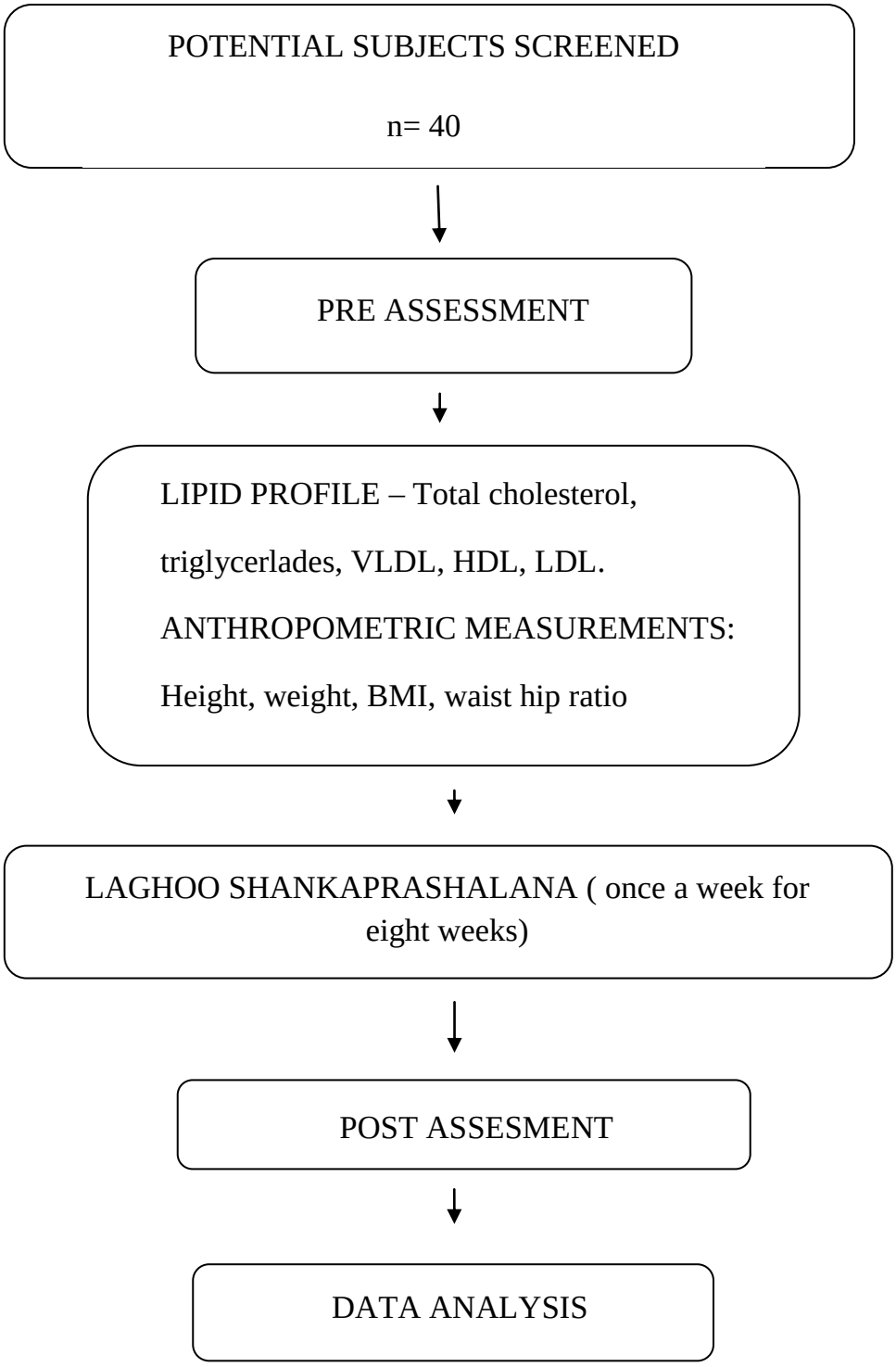
Waist Hip ratio (in centimeters) will be measured by using a non-stretchable measuring tape. Waist circumference was measured at the smallest horizontal girth between the costal margins and the iliac crest at the end of expiration and finally lipid profile will be assessed by hematological test before giving intervention After selecting the subjects, practice of laghoo shankaprashalana will be started. Practice of laghoo shankaprakshalana will be 4 sittings per month (weekly once) for 2 months.

4.11 DATA COLLECTION:

1. Base line (before): Height, Weight, BMI, Waist circumference, Hip circumference, Waist Hip Ratio and Lipid profile-Total cholesterol, Triglycerides, Very Low Density Lipoprotein, High Density Lipoprotein, Low Density Liporotein were measured prior to the intervention studies.

2. After 8weeks: Weight, Body Mass Index, Waist circumference, Hip circumference, Waist Hip Ratio and Lipid profile-Total cholesterol, Triglycerides, VLDL, HDL, LDL were measured after the intervention period.

Figure 14 ILLUSTRATION OF STUDY PLAN



LAGHOO SHANKAPRASHALANA PROCEDURE

Preparation:

It is advisable to take a light, semi-liquid meal the night before undertaking this practice. Plenty of clean, lukewarm water should be available and also extra hot water in case the temperature of the water falls below body temperature. Add 2 teaspoons of salt per litre to the water, so that it tastes mildly salty.It is necessary for a special food of good quality white rice and pulse, preferably mung dal, cooked with *ghee,* clarified butter, to be prepared.

This preparation is called *khicheri.* The rice and lentils should be cooked together in water until soft. A little *haldi,* turmeric, may be added, but no salt. Finally, the clarified butter should be liberally mixed in so that the final preparation is semi-liquid. If the bowels are not evacuated prior to the practice it helps stimulate the peristaltic movement.Light and comfortable clothing should be worn.

Time of practice:

Laghoo should be practised in the morning when the stomach is completely empty, before any food or drink is taken.

Laghoo Shankhaprakshalana (short intestinal wash)

Preparation:

It is advisable to take a light, semi-liquid meal the night before undertaking this practice. Plenty of clean, lukewarm water should be available and also extra hot water in case the temperature of the water falls below body temperature. Add

2 teaspoons of salt per litre to the water, so that it tastes mildly salty. Quickly drink two glasses of the prepared water.

Figure 15: Water drinking

Perform the five shankhaprakshalana asanas eight times:

a) Tadasana b) Tiryakatadasana c) Kati chakrasana d) Tiryakabhujangasana

e) Udarakarshanasana.

Drink two more glasses of water and repeat the asanas eight times each. Repeat the process for a third and last time. Go to the toilet but do not strain whether there is a bowel movement or not. If there is no motion immediately, it will come later on.

Rest: On completion of the practice rest for half an hour before taking any food or drink.

Tadasana (palm tree pose)

Figure 16: Tadasana

Procedure:

Stand with the feet together or about 10 cm apart, and the arms by the side. Raise the arms over the head. Interlock the fingers and turn the palms upward. Place the hands on top of the head. Fix the eyes at a point on the wall slightly above the level of the head. The eyes should remain fixed on this point throughout the practice. Inhale and stretch the arms, shoulders and chest upward. Raise the heels coming up onto the toes. Lower the heels while breathing out and bring the hands to the top of the head. This is one round.(99)

TiryakaTadasana (swaying palm tree pose)

Figure 17: Triyaka Tadasana

Procedure:

Stand with the feet about 2 feet apart. Fix the gaze on a point directly in front. Interlock the fingers and turn the palms outward. Inhale and raise the arms over the head. While exhaling, bend to the left side from the waist. Inhale and slowly come to the upright position. Repeat on the right side. From the upright position, exhale while bringing the arms down to the sides. This completes one round.(100)

Kati Chakrasana (waist rotating pose)

Figure 18: Katichakrasana

Procedure:

Stand with the feet about half a metre apart and the arms by the sides. Take a deep breath in while raising the arms to shoulder level. Breathe out and twist the body to the left. Bring the right hand to the left shoulder and wrap the left arm around the back. Bring the left hand around the right side of the waist. Look over the left shoulder as far as possible.

Keep the back of the neck straight and imagine the top of the spine is the fixed point around which the head turns Inhale and return to the starting position. Repeat on the other side to complete one round.(101)

Tiryaka Bhujangasana (twisting cobra pose)

Figure 19. Triyaka Bhujangasana

Procedure:

Assume the final position of bhujangasana with the legs separated about half a metre. The toes should be tucked under and the heels raised, so that the foot rests on the ball of the foot. The head should be facing forward instead of bending backward as in bhujangasana. Twist the head and upper portion of the trunk, and look over the left shoulder. Gaze at the heel of the right foot. Try to feel a diagonal stretch of the abdomen. Relax the back and keep the navel as close to the floor as possible. Return to the centre and lower the body to the floor. This is one round.(101)

Udarakarshanasana(abdominalstretchpose)

Figure: 20 Udharakarshasana

Procedure:

Sit in the squatting position with the feet apart and the hands on the knees. Breathe in deeply. Breathe out, bringing the right knee to the floor near the left foot. Using the left hand as a lever, push the left knee towards the right, simultaneously twisting to the left. Keep the inside of the right foot on the floor. Look over the left shoulder. Breathe in when returning to the starting position. Repeat on the other side of the body to complete one round.(101)

Special meal*:*

Exactly 45 minutes after completing laghoo shankhaprakshalana the specially prepared food, khicheri must be taken. Eating this meal at the correct time is essential. The rhythm of the body has been temporarily disturbed; however, 45 minutes after completion of the practice the digestive organs resume their

functions. The three components of khicheri are helpful in the restoration of correct digestive function. The clarified butter is necessary to coat the intestinal walls until the body produces a new lining. The rice provides a simple, easily digestible packing material in the form of carbohydrate, and creates mucus which also protects the inner lining of the alimentary canal.

The lentils supplement the diet by giving the body an easily digestible source of protein, and make for an all-round nutritious meal. A sufficient quantity of khicheri must be eaten to reline the intestines and keep the walls of the gut stretched, otherwise they may cramp due to the absence of the bulk to which they are accustomed. This bulk not only maintains the tone but aids the intestines to resume peristalsis. It is also important in order to prevent indigestion, diarrhoea and constipation.(101)

TIME PERIOD FOR DATA COLLECTION:

1. Base line (before): Lipid profile-Total cholesterol, Triglycerides, Very Low Density Lipoprotein , High Density Lipoprotein, Low Density Lipoprotein and Height, Weight, BMI, Waist circumference, Hip circumference, Waist Hip Ratio were measured prior to the intervention studies.

2.After 8weeks : Lipid profile-Total cholesterol, Triglycerides, Very Low Density Lipoprotein , High Density Lipoprotein, Low Density Lipoprotein and Weight, BMI, Waist circumference, Hip circumference, Waist Hip Ratio were measured after the intervention period.

5.0 RESULTS

The data obtained following the study were found to be normally distributed ac (Shapiro wilk's test).Hence 'Paired t test' was performed to assess the significant different within the group whereas data was extracted at both baseline and post intervention.

Sample Paired t test showed that study group had significantly improved lipid profile values. The change in the 'Total Cholesterol' was significantly improved in Pre test compared to Post test ($P<0.0001$). Compared to that of the Pre test 'Triglycerides' value shows significant improvement in the Post test ($p<0.0001$). There was a significant difference within the group for the values recorded following the VLDL ($p<0.0001$).

Within group comparison, HDL and LDL value showed a significant changes *p* value for HDL and p value for LDL respectively. 'Simple Paired t test' showed that post test had significant improvement on Body Mass Index and Waist Hip ratio compared to that of the pre test.

Primary Outcome Variables	Pre	Post	t Stat	*p* Value
Lipid Profile				
Total Cholesterol	147.675	137.325	35.70272	0.0001*
Triglycerides	124.325	108.7	42.65009	0.0001*
Very Low Density Lipoprotein	24.865	21.74	42.65009	0.0001*
High Density Lipoprotein	30.775	33.925	-7.61265	0.0001*
Low density Lipoprotein	92.035	81.66	21.07191	0.0001*

p-Probability

Table 5: Result of Primary Outcome Variables

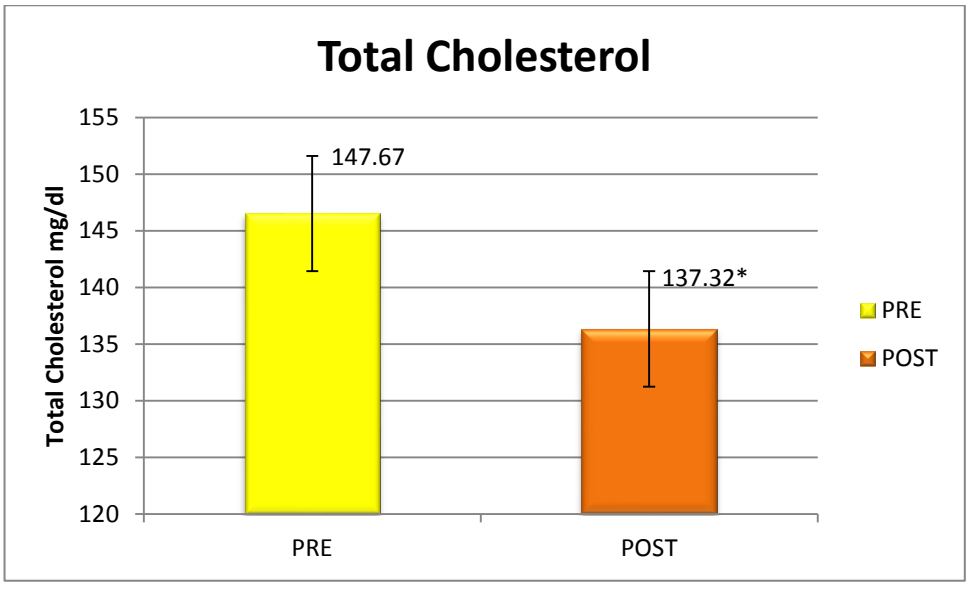


Figure 21: Comparison between Pre & Post values of Total Cholesterol in a Bar diagram

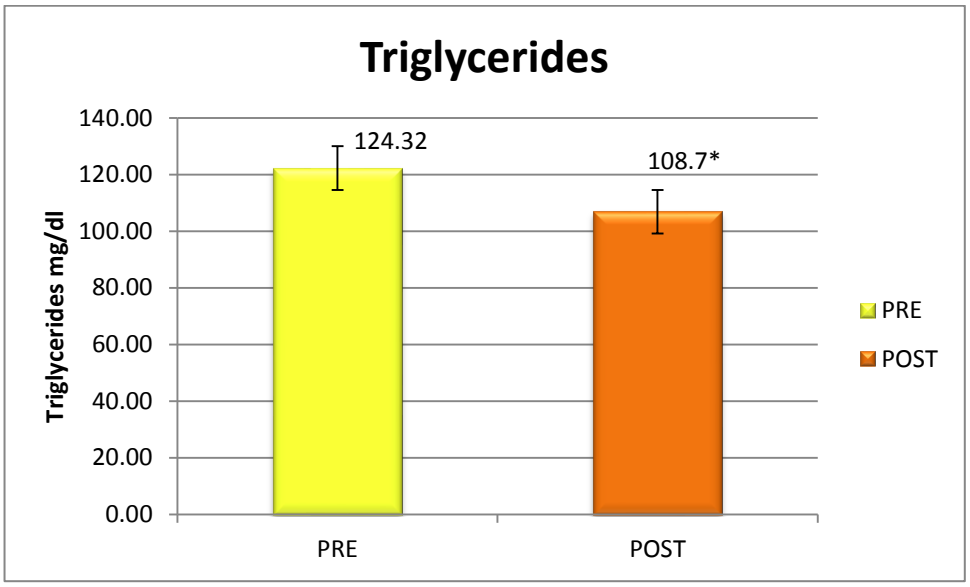


Figure 22: Comparison between Pre & Post values of Triglycerides in a Bar diagram

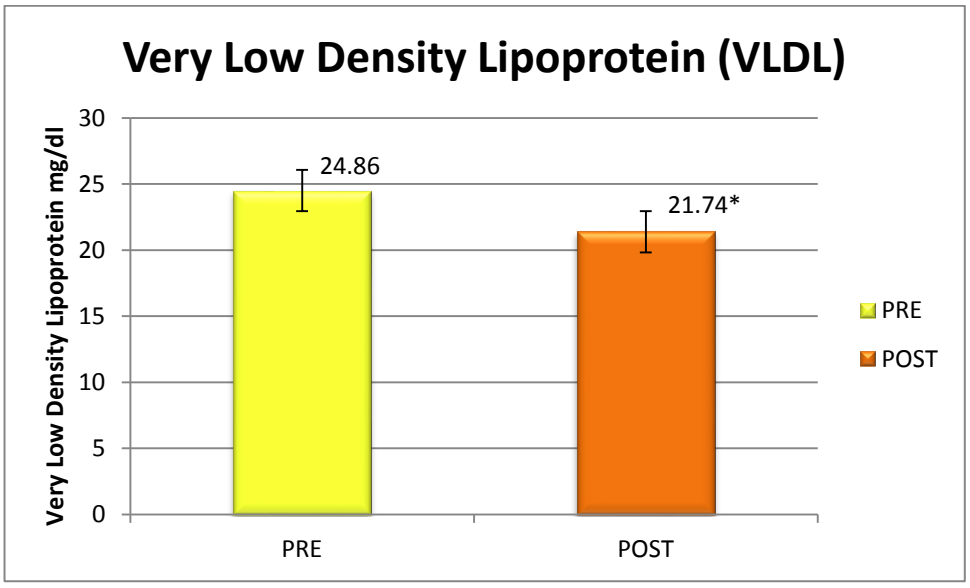


Figure 23: Comparison between Pre & Post values of Very Low Density Lipoprotein (VLDL) in a Bar diagram

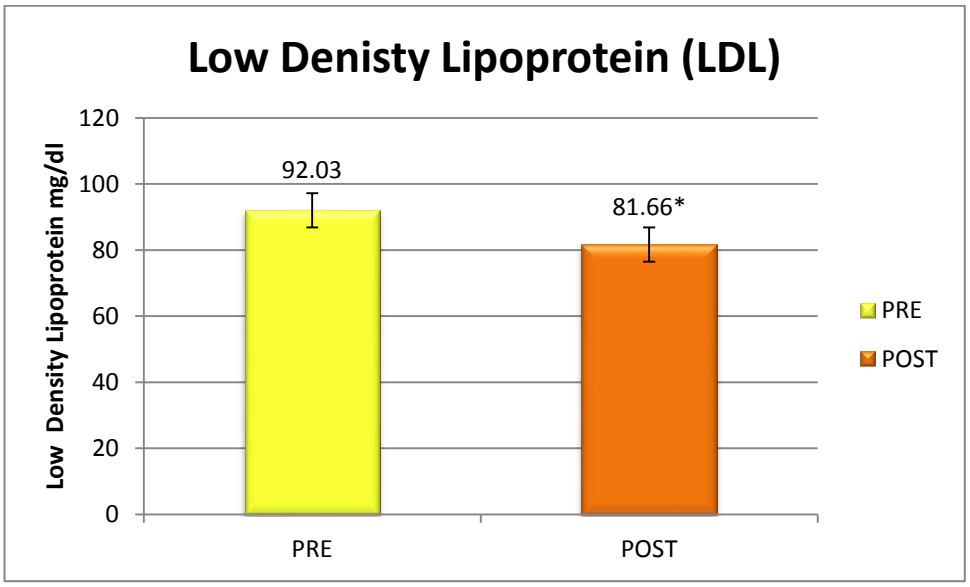


Figure 24: Comparison between Pre & Post values of Low Density Lipoprotein (LDL) in a Bar diagram

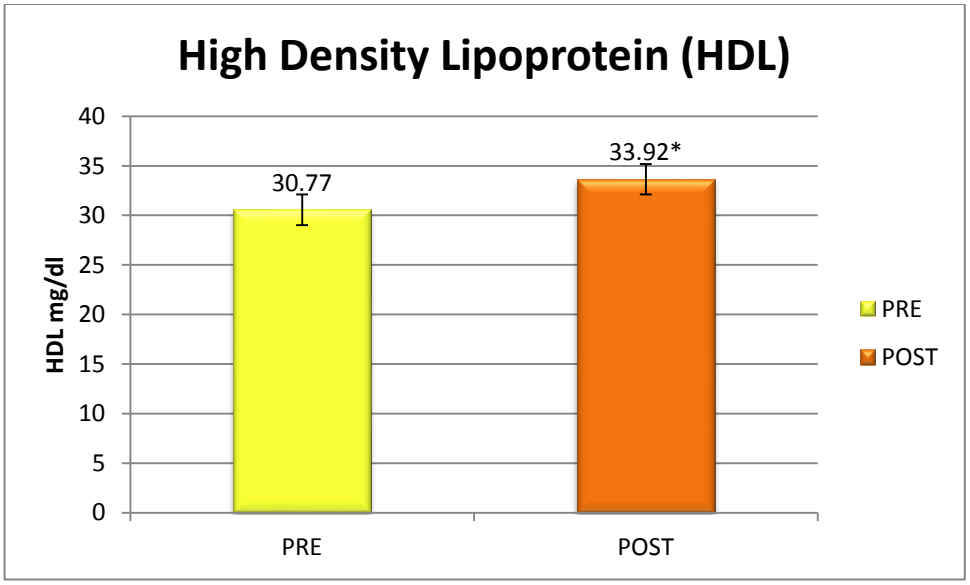


Figure 25: Comparison between Pre & Post values of High Density Lipoprotein (HDL) in a Bar diagram

Secondary Outcome variables	Pre	Post	t Stat	*p* Value
Weight in KG	87.825	82.7	22.30275	0.0001*
Body Mass Index	34.07875	32.055	20.14068	0.0001*
Waist Circumference	111.825	103.625	37.05352	0.0001*
Hip Circumference	119.5	113.775	18.34221	0.0001*
Waist Hip Ratio	0.934417	0.911187	7.784766	0.000016*
Systolic Blood Pressure	114.75	114	0.368061	0.714
Diastolic Blood Pressure	78	77.5	0.247048	0.806
Pulse Rate	78.4	77.325	1.117819	0.270

Table 6: Results of Secondary Outcome Variables

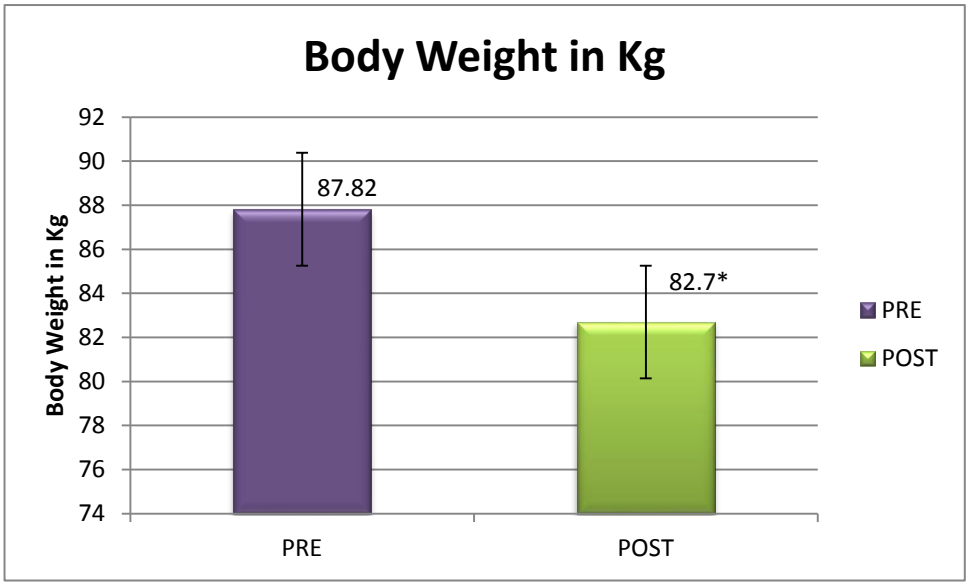


Figure 26: Comparison between Pre & Post values of Body Weight in kg in a bar diagram

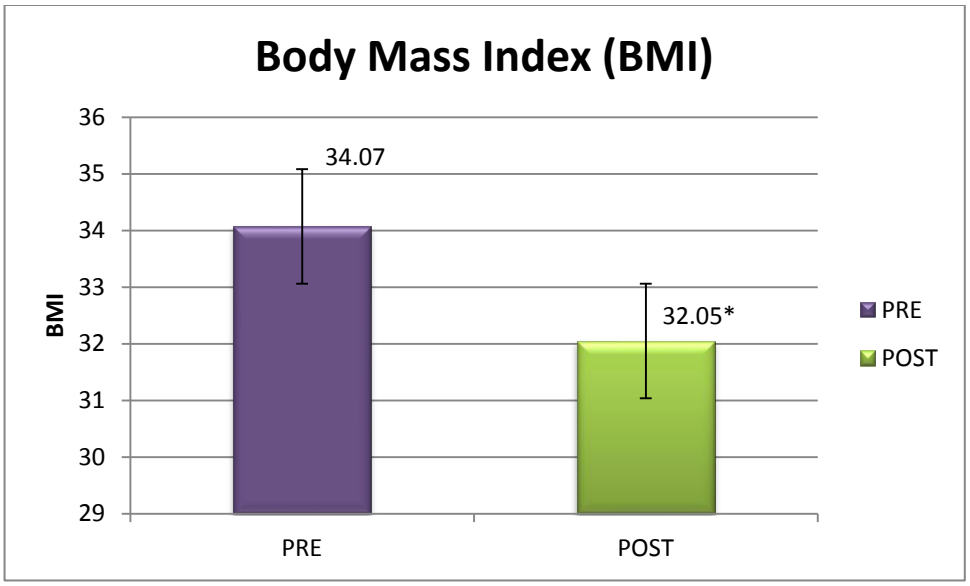


Figure 27: Comparison between Pre & Post values of Body Mass Index (BMI) in a Bar diagram

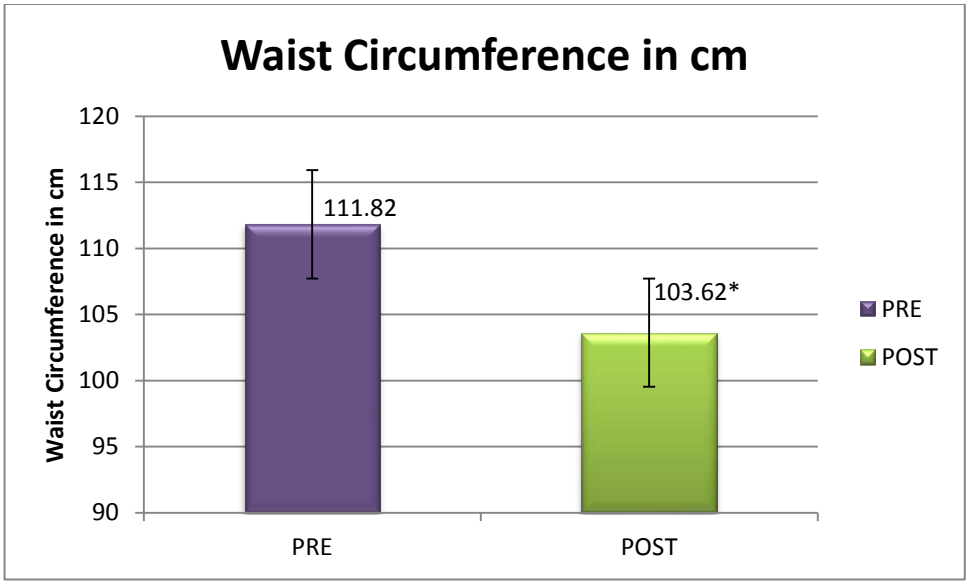


Figure 28: Comparison between Pre & Post values of Waist Circumference in a Bar diagram

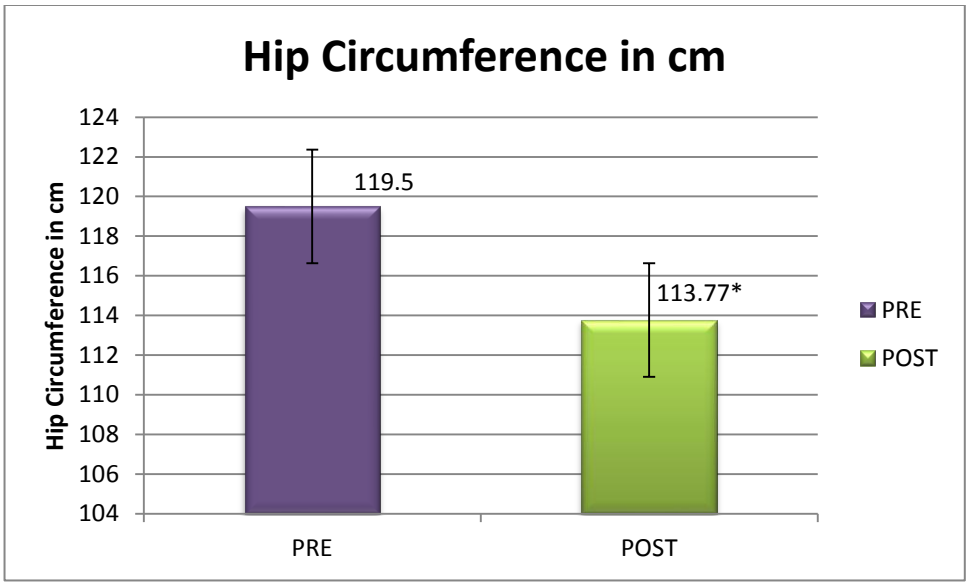


Figure 29: Comparison between Pre & Post values of Waist Circumference in a Bar diagram

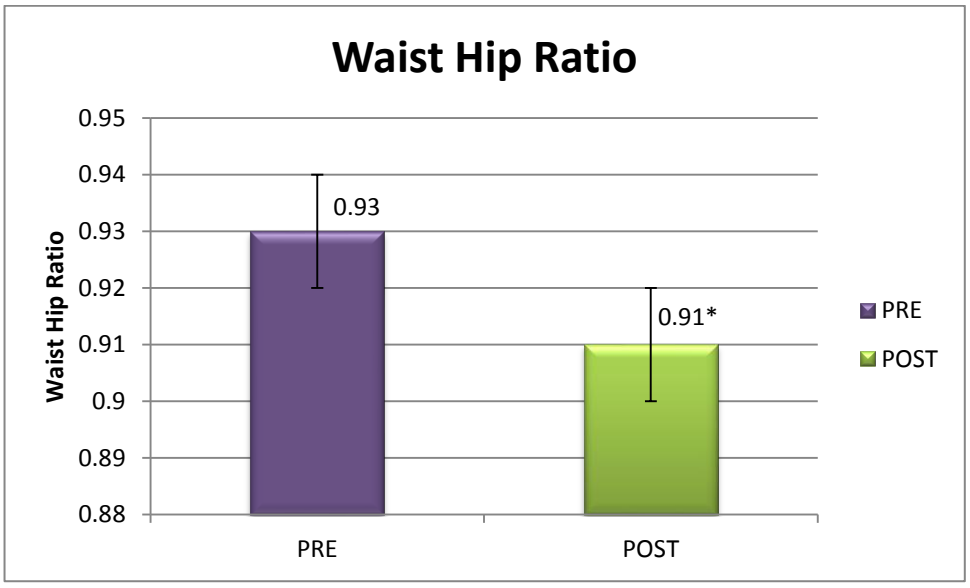


Figure 30: Comparison between Pre & Post values of Waist Hip Ratio in a Bar diagram

6.0 DISCUSSION

This present study shows that practice of Laghoo Shankaprakshalana *(LSP)* for the period of 8 weeks having a significant improvement in lipid profile and anthropometric measurements positively. When compared from pre-test and post-test, *LSP* had significantly decreased in Serum cholesterol, triglycerides, low density lipoprotein and increase in high density lipoprotein.

LSP has been used effectively for reducing the serum cholesterol level. Studies have shown the possibilities of improving the lipid levels and reducing the serum cholesterol level following twice a week for 90 days. (66)The result of the present study related to reduce serum cholesterol appears to be in live with the above findings.

Bile is a complex fluid containing various substances, some of which are merely waste products undergoing excretion. Another study concluded that Laghu Shankhaprakshalana *(LSP)* also reduces the bile acid pool. Cholesterol, one of the chief constituents of bile, is also reduced resulting in reduced fat (both triglyceride and cholesterol) absorption for the next several days and thus it can help to reduce weight.(66)

Studies concluded that Regular practice of Shankhaprakshalana & Asana does reduce blood sugar levels, the blood pressure, weight, the rate of progression to the complications, and the severity of the complications as well.(68)

Overall the practice of Laghu shankaprakshalana *(LSP)* among obese individuals had an effect on regulating the Serum cholesterol, triglycerides, high density lipoprotein, and low density lipoprotein. It also helps to reduce the body weight and waist hip ratio as well.

7.0 CONCLUSSION

Thus the study concludes that the study group had significant improvement in the lipid profile of the subjects and also there is reduction in body weight, Body Mass Index and Waist Hip ratio. Hence laghoo shankaprakshalana can be used as the effective tool for obesity and dyslipidemia.

7.0.1 LIMITATIONS:

1. The current study was a pilot study comprising only of minimal number of Subjects.

2. Only one experimental group was included, control group was not assigned.

3. Variables like fat analyzer have not been used.

7.0.2 RECOMMENDATIONS:

- The same study can be conducted on a larger population with suitable study design and some objective kind of outcome variables could be included to validate the current results.
- In future more evidence based researches has to be done on laghoo shanka prakshalana.
- Use of these kinds of traditional cleansing practises has to be implemented in modern medicine, since they have a variety of advantages.

8.0 SUMMARY

The World Health Organization (WHO) considers obesity to be one of the most serious public health challenges of the 21st century. The health risks of obesity are a forever growing concern for societies worldwide. Obesity has a negative impact on health and quality of life. It is chronic and multi-factorial disease and one of the most important causes of morbidity and premature mortality seen worldwide. Studies show that Shatkriyas had reduced lipid profile and body weight. The aim of this review was to systematically assess and analyze the effects of Shatkriyas on weight-related out comes. The present Pre and Post experimental study was planned to evaluate the effect of Laghoo shankaprakshalana on lipid profile and anthropometric measurements in obese individuals. A total of forty subjects, mean aged (Male 22.33± 1 & Female 28.87 ± 6.2) were assigned into study after satisfying the inclusion and exclusion criteria. Subjects were assessed at baseline and after 8 weeks for lipid profile like Total cholesterol, Triglycerides, Very Low Lipoprotein (VLDL), High Density Lipoprotein (HDL), Low Density Lipoprotein (LDL), and waist hip ratio. During these 8 weeks the subjects were practiced Laghoo Shankaprakshalana once a week. Sample paired t test showed that study group had significantly improved in lipid profile and there is reduction in body weight, Body Mass Index and Waist Hip ratio. Therefore, Post-test data clearly indicates that there is a significant difference of BMI and waist Hip Ratio, lipid profile than the pre-test data.

9.0 REFFERENCE

1. World Health Organization. Obesity and Overweight, Fact Sheet, October 2017, http://www.who.int/mediacentre/factsheets/fs311/en/.

2. National Research Council. Committee on Diet and Health. Implications for reducing chronic disease risk.Washington, DC: National Academy Press; 1989.

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10.0. ANNEXURE

10.1 Annexure 1

INFORMED CONSENT FORM

Title of the study: " To study the effect of Laghoo shakaprakshalana on Lipid profile and Anthropometric measurements in obese persons"

Name Of The Participant :

Name of the Principal Investigator : Dr.A.Gayathri

Name of the Institution : Government Yoga and Naturopathy Medical College and Hospital, Arumbakkam, Chennai - 600 106.

Documentation of the informed consent

I _____ have read the information in this form (or it has been read to me). I was free to ask any questions and they have been answered. I am over 18 years of age and, exercising my free power of choice, hereby give my consent to be included as a participant in “To study the effect of Laghoo shankaprakshalana on lipid profile and anthropometric measurements in obese persons”

1. I have read and understood this consent form and the information provided to me.

2. I have had the consent document explained to me.

3. I have been explained about the nature of the study.

4. I have been explained about my rights and responsibilities by the investigator.

5. I have been informed the investigator of all the treatments I am taking or have taken in the past _____ months including any native (alternative) treatment.

6. I have been advised about the risks associated with my participation in this study.

7. I agree to cooperate with the investigator and I will inform him/her immediately if I suffer unusual symptoms.

8. I have not participated in any research study within the past _____month(s).

9. I am aware of the fact that I can opt out of the study at any time without having to give any reason and this will not affect my future treatment in this hospital.

10. I am also aware that the investigator may terminate my participation in the study at any time, for any reason, without my consent.

12. I hereby give permission to the investigators to release the information obtained from me as result of participation in this study to the sponsors, regulatory authorities, Govt. agencies, and IEC. I understand that they are publicly presented.

13. I have understood that my identity will be kept confidential if my data are publicly presented.

14. I have had my questions answered to my satisfaction.

15. I have decided to be in the research study.

I am aware that if I have any question during this study, I should contact the investigator. By signing this consent form I attest that the information given in this document has been clearly explained to me and understood by me, I will be given a copy of this consent document.

For adult participants:

Name and signature / thumb impression of the participant (or legal representative if participant incompetent)

Name _____ Signature_____

Date_____

Name and Signature of impartial witness (required for illiterate patients):

Name _____ Signature_____

Date_____

Address and contact number of the impartial witness:

Name and Signature of the investigator or his representative obtaining consent:

Name _____ Signature_____

Date_____